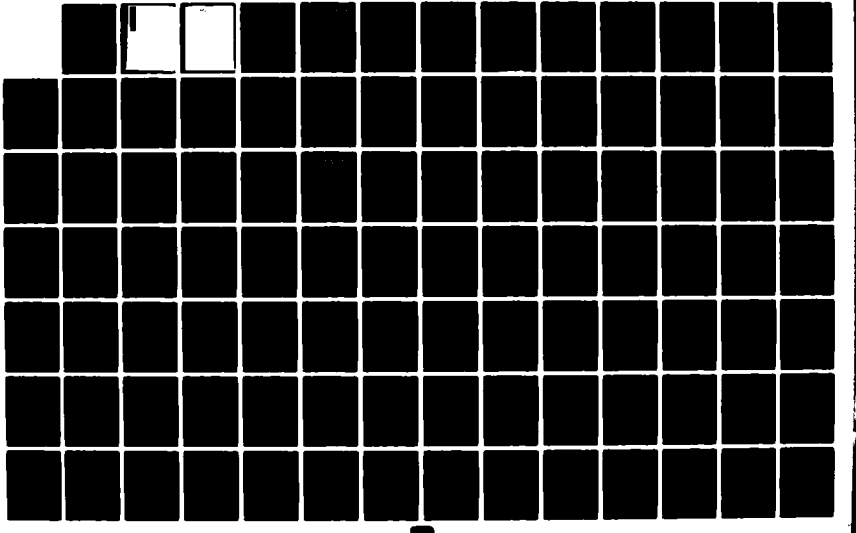
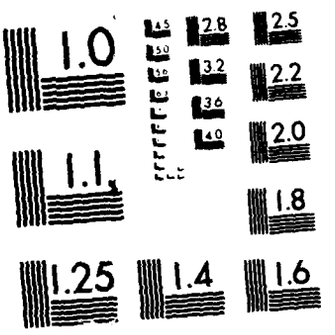
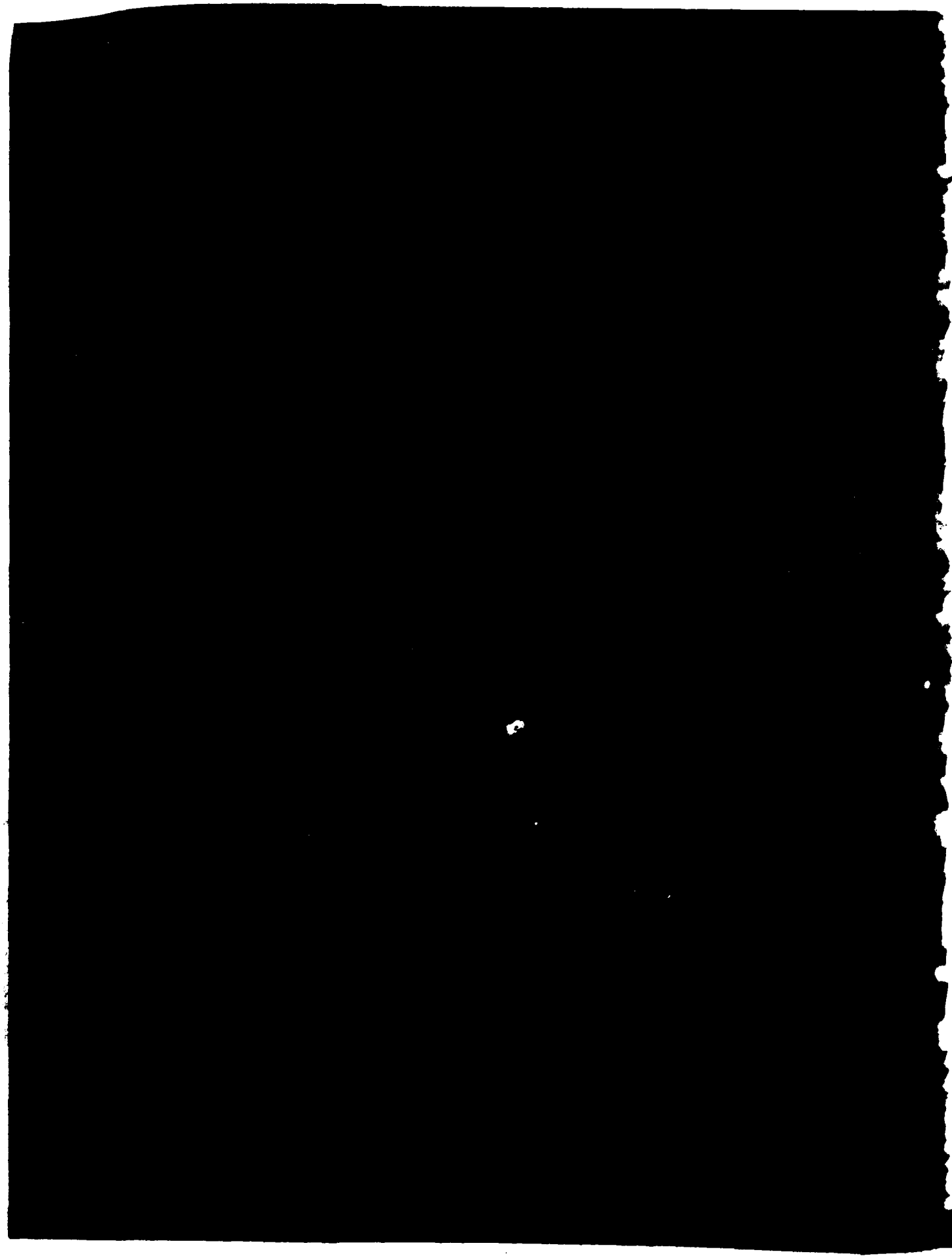
AD-A138 199 THE SHOCK AND VIBRATION DIGEST VOLUME 12 NUMBER 6(U) 1/2
NAVAL RESEARCH LAB WASHINGTON DC SHOCK AND VIBRATION
INFORMATION CENTER J NAGLE-ESHLEMAN JUN 80

UNCLASSIFIED F/G 20/11 NL







SVIC NOTES

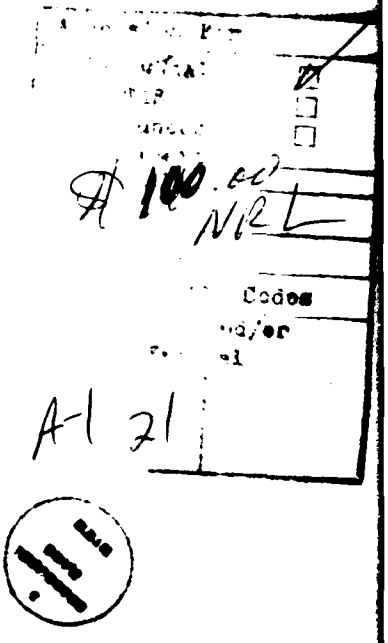
The weight saving advantages of composite materials are well known in the aircraft industry and service experience is being acquired on many airplane and helicopter structural components. Composite materials will be used in other applications where weight saving is an important design consideration. In addition, information concerning dynamic behavior of many types of structural elements fabricated from composite materials is available.

In spite of this, uncertainties concerning the behavior of composite materials still exist. For example, how do the natural environments affect their strength, fatigue resistance or their thermal expansion? How relevant are laboratory accelerated tests to the long term natural exposure of composite materials? What is the influence of simulated defects on the fatigue life of either graphite fiber or carbon fiber reinforced plastics? These and other questions were discussed in the specialists meeting on the Effect of the Service Environment on Composite Materials which was held during the 50th Meeting of the AGARD Structures and Materials Panel in Athens, Greece.

The Specialists Meeting was divided into five sessions where technical papers were presented. The first session covered the effects of the natural environments on the physical behavior of composite materials. Papers in the second session concerned the fatigue resistance of composite materials or composite material structural components. The impact resistance of composite materials was considered in the third session and the fourth session concerned the effects of lightning or rain errosion on composite material aircraft structural components. The damage potential from the accidental release of carbon fibers from aircraft composite materials that catch on fire was also discussed in the fourth session. The fifth session concerned the service experience with composite material structural components in helicopters and in commercial and military aircraft.

All of the papers were very interesting and many were relevant to the shock and vibration technology. Ample time was allowed for discussion after each paper or at the conclusion of each session and this made for a more interesting meeting.

R.H.V.



EDITORS RATTLE SPACE

PROLIFERATION OF THE LITERATURE - SOME BASIC CAUSES

The number of articles abstracted in the 1980 issues of the DIGEST reflects a 33% increase in the noise, shock, and vibration fields. Although this trend has continued long enough to indicate a large permanent increase in material published, there are no indications that more important discoveries are being made or that publication of application notes on engineering practice has increased.

At first this trend puzzled me because the real dollar volume of research has been on the downturn. After some thinking about the matter, however, I am prepared to suggest that the publication boom reflects increases in organizational activity and the number of journals published. Unfortunately, the number of articles containing meaningful information has not risen.

In the last five years the number of technical meetings has increased dramatically - in fact, an individual could attend a meeting on noise, shock, or vibration almost every week. A proceedings or special issue of a journal is usually associated with each meeting. More meetings mean more articles. But this does not mean more good technical material.

Another new source of articles is the increasing number of journals published that have no affiliation with established technical societies. In addition, many societies have increased the quantity of material they publish by initiating new journals.

What does this mean to those involved in publishing, handling, and using technology? To the information system developers it means more literature to retrieve and thus larger computers. To the librarians it means huge organizational and budgetary headaches. To the publishers it means less profits eventually. To the engineer it means more literature to sort through for worthwhile data.

When will the boom end? At the current rate of increase and escalating costs, I believe that the large technical libraries will drop out first because they will not be able to maintain complete coverage of all the literature in specific fields. They will be replaced by smaller specialized libraries. And this will mean hard times for publishers because they depend on a large number of library subscriptions to maintain a financially viable circulation. Perhaps the number of journals will automatically decrease as large libraries become more selective.

In my opinion, however, better solutions to this developing problem are available if the engineering profession is willing to discipline itself. Turn to this page next month for my suggested solutions.

R.L.E.

STABLE RESPONSE OF DAMPED LINEAR SYSTEMS

D.W. Nicholson*

***Abstract** - This review concerns investigations the object of which is to determine simple conditions on the damping matrix under which a linear mechanical system is stable. A Lyapunov theorem and several examples are discussed. Some recent results are also mentioned on conditions for subcritical damping in all modes, in which event the response is oscillatory damped.*

Response of Linear Systems

This review concerns the stability characteristics of a linear mechanical system whose vibrations are governed by the equation

$$M\ddot{x} + D\dot{x} + Kx = f(t)$$
$$x(o) = x_o \quad \dot{x}(o) = \dot{x}_o \tag{1}$$

M, D, and K are the inertial, damping, and stiffness matrices; f is the time dependent vector of applied forces; t is the time; x is the displacement vector to be determined; and the superposed dot implies time differentiation. All matrices are symmetric, and M and K are positive definite. Broadly speaking, the system is stable with respect to f(t) if x(t) remains bounded for $t > o$.

A recent monograph [1] contains an extensive review of the stability characteristics of the system under study. Some important results discussed in the monograph, as well as some developments since its publication, are given in this article.

With the notation

$$y = \begin{Bmatrix} \dot{x} \\ x \end{Bmatrix} \quad y_o = \begin{Bmatrix} \dot{x}_o \\ x_o \end{Bmatrix} \quad g = \begin{bmatrix} M^{-1} & o \\ o & K^{-1} \end{bmatrix} \begin{Bmatrix} f \\ o \end{Bmatrix}$$

the magnitude of the solution vector is bounded by [2, 3]

$$|y| \leq |y_o| + \int_o^t |g(\tau)|\, d\tau \tag{2}$$

if the eigenvalues of the matrix A given by

$$A = \begin{bmatrix} M^{-1} & o \\ o & K^{-1} \end{bmatrix} \begin{bmatrix} D & K \\ -K & o \end{bmatrix}$$

have positive real parts. In this event A is called a stable matrix [4], and stability of A assures a certain type of physical stability. Namely, from equation (2) the magnitude of the displacement remains bounded if the integral of the magnitude of the forcing function is bounded.

Stability Conditions

According to a theorem attributed to Lyapunov [4], a necessary and sufficient condition for A to be stable is that there exist a positive definite matrix B such that $AB + BA^T$ is positive definite, where A^T is the *transpose of* A.

If D is positive definite, it has been proved [3] that the Lyapunov condition is satisfied and A is stable. But positive definiteness of D is not in general necessary for the stability of A, as has been shown by a counterexample [1]. However, it is necessary in the case in which equation (1) can be expressed as the decoupled system

$$m_i \ddot{x}_i + d_i \dot{x}_i + k_i x_i = f_i$$

for i = 1, 2, ..., n. The necessary and sufficient condition for this decoupling has been given [5] as

$$DM^{-1}K = KM^{-1}D \tag{3}$$

Judging by the work of Müller [1], beyond the results discussed above, little progress has been made in applying the Lyapunov theorem to obtain simple

*Naval Surface Weapons Center, White Oak, Silver Spring, Maryland 20910

conditions on D assuring stability. There is some promise in a recent result giving the best possible bounds on the eigenvalues of $AB + BA^T$ [6]. The object now is to determine a positive definite matrix B for which the lower bound is positive if A is stable. It is hoped that there will be progress soon on this important problem.

DAMPED OSCILLATORY SYSTEMS

Finally, some recent developments have been reported concerning the case of damped oscillatory motion. All modes of equation (1) will be oscillatory damped if the matrices D and $4K\text{-}DM^{-1}D$ are positive definite [7]. Further, if all modes are oscillatory damped, either certain complicated matrices are of rank n-2 or the modes are uncoupled and D is positive definite [8].

Necessary Conditions

Two necessary conditions on D, obtained from the Routh-Hurwitz method, are

$$\text{trace}(M^{-\frac{1}{2}}DM^{-\frac{1}{2}}) \geq 0 \quad \text{trace}(K^{-\frac{1}{2}}DK^{-\frac{1}{2}}) \geq 0.$$

The left hand condition, given by Müller [1], is usually easy to apply because M is diagonal in most cases.

CONCLUSION

The object is to derive simple conditions on D assuring stable response to a large class of input functions. For a certain level of stability, positive definiteness of D is sufficient but not, in general, necessary. Additional results can be obtained for uncoupled and for damped oscillatory motions. Further, there is some hope of further progress by applying the Lyapunov theorem.

REFERENCES

1. Müller, P.C., Stabilität and Matrizen, Springer-Verlag (1977).

2. Luenberger, D.G., Introduction to Dynamic Systems, John Wiley and Sons (1979).

3. Nicholson, D.W., "A Stability Theory for a Dynamically Loaded Linear Viscoelastic Structure," Shock Vib. Bull., U.S. Naval Res. Lab., Proc., 49, Pt. 2, pp 203-207 (Sept 1979).

4. Young, D.M., Iterative Solution of Large Linear Systems, Academic Press (1971).

5. Caughey, T.K. and Kelley, M.E.J., "Classical Normal Modes in Damped Linear Systems," J. Appl. Mech., Trans. ASME, 32 (2), pp 583-588 (1965).

6. Nicholson, D.W., "Eigenvalue Bounds for $BA + AB^H$," submitted for publication.

7. Müller, P.C., "Oscillatory Damped Linear Systems," Mech. Res. Comm., 6 (2), pp 81-85 (1979).

8. Nicholson, D.W., "Comments on Damped Response in Linear Systems," Mech. Res. Comm., 6 (1), pp 17-25 (1979).

LITERATURE REVIEW

survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles include technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

This issue of the DIGEST contains an article about modeling of fluid transients in machines.

Dr. R. Singh of the Departmet of Mechanical Engineering, Ohio State University, has written a paper which presents a state-of-the-art literature review of the mathematical modeling of fluid transients in machines. Part I deals with the basic equations, assumptions, and various factors involved with the models. Also discussed are typical boundary conditions, source descriptions, and solution methods as pertinent to the machines. Part II deals with applications and advanced considerations.

MODELING OF FLUID TRANSIENTS IN MACHINES
Part I: Basic Considerations

R. Singh*

Abstract - This paper presents a state-of-the-art literature review of the mathematical modeling of fluid transients in machines. Part I deals with the basic equations, assumptions, and various factors involved with the models. Also discussed are typical boundary conditions, source descriptions, and solution methods as pertinent to the machines. Part II deals with applications and advanced considerations.

Fluid transients in machines can be induced in a number of ways: (a) machinery periodicity, in which inherent fluid oscillations are excited at the fundamental and higher harmonics of machinery running speeds; (b) unstable operation, in which a change in operating characteristics can cause fluid transients; (c) structural excitation, in which vibrating structures and boundaries around the fluid can produce a dynamic coupling between solid parts and fluid flow; (d) abrupt change in initial/boundary conditions, for example, sudden changes in running speed and load, or in a valve in the piping; and (e) self-excited oscillation mechanisms, for example, when fluid flows around a solid object or in and past cavities. Of primary interest in machines is periodic or pulsating flow.

Fluid transients can affect the thermodynamic and dynamic performance characteristics of a machine. Fluid transients are generally undesirable because they cause structural vibrations, noise radiation, fatigue, and failure problems. However, in special cases flow pulsations can be used to obtain better mass flow requirements.

Because the design of fluidmachines is often based on steady flow analysis, the problems associated with transients and pulsations must be solved after the design process. A mathematical model of the machine and analysis of fluid transients are necessary in order to characterize instabilities, resonances, and pressure variations. Increasing thermodynamic efficiencies and higher speeds, as well as smaller size and lower costs, dictate that adequate attention be given to the dynamic aspects of fluid transients during the machine design process.

OBJECTIVES

The problems involved in analyzing and controlling fluid transients in machines have always been recognized. But the solution of basic equations in general form was difficult unless certain simplifying assumptions were made. The advent of high-speed digital computers has made numerical solutions possible.

This paper reviews literature since 1970; advances before 1970 are well documented [1-10]. Some research is included in books [11, 12], even though they focus on the analysis of transients in hydraulic piping systems. The literature reviewed in this article is pertinent to machines in which gas and liquid serve as the working media. Piping and other components and their dynamic interrelationships are important; models are therefore required.

BASIC EQUATIONS AND ASSUMPTIONS

Consider one-dimensional ideal flow with negligible friction losses and heat transfer effects. The Navier-Stokes equation, continuity equation, and the equation of state are as follows.

$$\frac{\partial u_t}{\partial t} + u_t \frac{\partial u_t}{\partial x} + \frac{1}{\rho_t} \frac{\partial p_t}{\partial x} = 0 \qquad (1)$$

$$\frac{\partial \rho_t}{\partial t} + u_t \frac{\partial \rho_t}{\partial x} + \rho_t \frac{\partial u_t}{\partial x} = 0 \qquad (2)$$

$$c^2 = \frac{\partial p_t}{\partial \rho_t} \qquad (3)$$

*Department of Mechanical Engineering, The Ohio State University, 206 W. 18th Avenue, Columbus, Ohio 43210

P, ρ, u, and c are pressure, density, velocity, and speed of wave propagation respectively; subscript t implies total instantaneous values. Time and longitudinal coordinate are denoted by t and x.

Method of characteristics. The partial differential equations can be solved by the method of characteristics; these three equations can be reduced to two differential equations known as the characteristic equations. Subscripts + and − refer to the wave propagation in the +x and −x directions respectively.

$$dp_{t_{\pm}} \pm \rho_t c\, du_{t_{\pm}} = 0 \qquad (4\text{-a})$$

$$\frac{dx}{dt} = \lambda_{\pm} = u_t \pm c \qquad (4\text{-b})$$

These wave equations can be solved in the x − t plane using finite difference techniques [11-16]. Initial and boundary conditions can easily be specified, and the pressure distribution and time history can be calculated. The model is potentially very accurate because it can handle nonlinear effects; however, it might be limited by the cost of analysis. The model can incorporate any variation of c with p_t and ρ_t. But the velocity of wave propagation c could be considered a constant c_o to simplify the analysis. Subscript o implies mean or steady values.

$$\text{Liquids: } c^2 \simeq c_o^2 = \left(\frac{\partial p_t}{\partial \rho_t}\right)_o = B_\ell/\rho_o \qquad (5)$$

B_ℓ is the bulk modulus of the liquid.

$$\text{Gases: } c_o = \left(\frac{\partial p_t}{\partial \rho_t}\right)_o = k\,\frac{P_o}{\rho_o}; \qquad (6)$$

$$c^2 = c_o^2\,(\rho_t/\rho_o)^{k-1} \qquad (7)$$

where k is the adiabatic constant. The assumption of a perfect gas helps in simplifications; consequently c (as opposed to c_o) can be retained for the analysis [4, 11, 14, 15, 19-21]. Computer programs based on the method of characteristics are available [12, 14, 21].

Linearized wave equation. Equations (1) and (2) are nonlinear; thus their general solution presents a difficult problem. The equations, which can be linearized by assuming small amplitudes for the perturbations, are given below without any subscript.

$$P_t(x,t) = p_o + p(x,t) \quad , \quad p(x,t) \ll p_o \qquad (8)$$

$$\rho_t(x,t) = \rho_o + \rho(x,t) \quad , \quad \rho(x,t) \ll \rho_o \qquad (9)$$

$$u_t(x,t) = u_o + u(x,t) \quad , \quad \text{assuming } u_o = o \qquad (10)$$

$$c^2 = c_o^2 \qquad (11)$$

Equations (1-3) and equations (8-11) yield the following classical wave equation.

$$\frac{\partial^2 p}{\partial t^2} = c_o^2\,\frac{\partial^2 p}{\partial x^2}\,, \text{ and } p_{\pm} = \pm \rho_o c_o\, u_{\pm} \qquad (12)$$

The general harmonic solution is

$$p(x,t) = [P_+ e^{-\gamma x} + P_- e^{\gamma x}]\; e^{j\omega t}\;;\; \gamma \simeq j\omega/c_o \qquad (13)$$

P is the amplitude, γ is the propagation constant, and ω is the circular frequency. The linearized wave model is reasonably valid up to $p/p_o = 0.1$ and can be extended depending upon the application, nature of the fluid, and the objective of the analysis [11, 12, 22, 23]. The linear model has such attractive features as ease of developing a mathematical model for machinery components and initial/boundary conditions, a building block approach, and combining theoretical models and experimental test data [12, 23-36]. Linear models are often described using fluid impedance (Z) and/or matrix methods [5-12, 23-36].

$$Z_x = p_x/Su_x \simeq p_x/Q_x \qquad (14)$$

S is the cross-sectional area and Q is the volume velocity. For a piping of length ℓ, upstream variables (u) can be described as a function of downstream variables (d) and inherent dynamic characteristics of the piping fluid as given by the propagation constant γ and characteristic impedance Z_c ($= \rho_o c_o/S$).

$$\begin{Bmatrix} p \\ Q \end{Bmatrix}_u = \begin{bmatrix} \cosh \gamma \ell & Z_c \sinh \gamma \ell \\ \frac{1}{Z_c} \sinh \gamma \ell & \cosh \gamma \ell \end{bmatrix} \begin{Bmatrix} p \\ Q \end{Bmatrix}_d \quad (15)$$

When the component dimensions are small compared to the wavelength of sound, fluid systems can be discretized and a lumped parameter model of the following type can be established.

$$I \frac{dQ}{dt} + K \int Q dt = o \quad (16\text{-a})$$

or

$$Z(\omega) = j\omega I + (K/j\omega) \quad (16\text{-b})$$

$$\text{fluid inertia} = I = \rho_o \ell_I / S_I$$

$$\text{fluid stiffness} = K = \rho_o c_o^2 / V_k \quad (17)$$

when ℓ_I and S_I are the length and cross-sectional area of the inertial element, and V_k is the volume of the stiffness or compliance (1/K) element.

Factors to be considered. Factors include convective effect, gas bubbles, friction, turbulence, heat transfer effects, and non-circular cross sections. The convective effect can be expressed as the effective speeds of wave propagation (c_o') in the direction of flow (+) and opposite to flow (−)

$$(c_o')_{\pm} = c_o \pm u_o \quad (18)$$

Gas bubbles in liquids and pipe elasticity are expressed in equation (19)

$$c_o' = [B_m/\rho_m) / (B_m/Ed)]^{1/2} \quad (19)$$

B_m and ρ_m are the mixture bulk modulus and density; and E, h, and d are the modulus of elasticity, thickness, and diameter respectively of the piping wall [12].

Energy dissipation losses (friction) can be considered proportional to the u(x, t); when included in the wave equation, equation (12), the losses become

$$\frac{\partial^2 p}{\partial t^2} = c^2 \frac{\partial^2 p}{\partial x^2} - \frac{R}{\rho_o} \frac{\partial p}{\partial t} \quad (20)$$

R is the fluid resistance per unit area and length. This can be combined with γ (as a part of the attenuation factor α) to keep the same harmonic solution

$$\gamma = \alpha + j \frac{\omega}{c_o} = \frac{R}{2\rho_o c_o} + j \frac{\omega}{c_o} \quad (21)$$

R depends on the application; e.g., for laminar flow at low frequencies, $R \simeq 32\,\mu/d^2$ (Poiseuille's law). For higher frequencies $R \simeq (8\rho_o \mu\omega/d^2)^{1/2}$ (Stokes's law) where μ is the fluid viscosity and d is the piping diameter. For laminar flows, R can also be computed using Darcy-Weisbach/Fanning friction formulations or experimentally derived attenuation factors [37-41].

An eddy viscosity model for high frequencies is similar to the viscosity model for laminar flows [6, 41-44]. However, over the mid-frequency or transitional range, reliable models are not available. Turbulence can similarly interact with the transient flow and fluid perturbations may be amplified [6].

When thermal conductivity and heat transfer effects are important, an energy equation is necessary in addition to equations (1) and (2). Models for both the method of characteristics [11, 14, 15] and the linearized wave equation [5, 11, 12] are available. Empirical expressions relating viscosity, eddy viscosity, and thermal conductivity to the attenuation factor α are also available [6].

In general all formulations assume that the cross-sectional area is circular. For non-circular cross sections an equivalent radius can be defined that would give the same dynamic response [45-50].

BOUNDARY CONDITIONS

Some typical boundary conditions generally encountered in machines and associated piping system are described in this section [5-12, 51-53]. The boundary conditions for the linearized wave equation model, equations (12-14), are described. For the method of characteristics similar models for the boundary conditions have been documented [11-21, 54].

- Closed end: $Z \simeq \infty$ (22)
- Open end or large tank: $Z \simeq o$ (23)

- Very long pipe or anechoic termination:

$$Z \simeq Z_c = \rho_o c_o / S \qquad (24)$$

- Sudden geometry change: Z is continuous at the boundary or interface
- Branching: at the interface of the main line and n branches, the impedance condition is

$$\frac{1}{Z_{line}} = \frac{1}{Z_1} + \frac{1}{Z_2} + \cdots + \frac{1}{Z_n} \qquad (25)$$

- Series elements: Z is continuous at the interface of two elements in series
- Parallel elements: at both interfaces, branching condition as given above needs to be satisfied
- Partial restrictions such as valves, ports, orifices, nozzles: flow and pressure conditions must be satisfied [12, 54].

The mathematical models of boundary conditions when the energy equation is included are available [54, 55].

DESCRIPTION OF MACHINERY SOURCES

The most difficult aspect is modeling machinery sources and characteristics. Some of the common models follow.

- Pressure source with source impedance; if the source impedance is negligible, it is a constant pressure source.
- Flow source with source impedance; if the source impedance is infinite, it is a constant flow source.
- Empirical models of source impedances are based largely on measurements [56-59]. One such model suggests that the internal combustion engine is a constant incidence amplitude source at high frequencies [57].
- Mathematical modeling of machinery processes is a direct method in which the source is not only desired completely and realistically but the interactions between the machinery processes and transients are also accounted for [11, 12, 60-66, 68]. In such models all equations are solved simultaneously using digital or analog computers.

SOLUTION TECHNIQUES

Ease of computation sometimes determines the selection of a particular approach. Early analyses were either graphical or were carried on analog computers [1-4, 9-12, 66]; the recent thrust is to digital computations [7, 11, 23], and a hybrid computer might prove to be more attractive [67, 68]. Solution techniques range from finite differences [13-21], transfer matrices or equations [25-33, 55], and the impedance concept [23, 37, 56, 61] to the bond-graph method [62] and Green's function approach [23].

The solution can be obtained in either the time domain or frequency domain. Truly transient problems are usually handled in the time domain. Moreover, fluid pulsations interacting with machinery processes are also visualized in the time or cyclic domain. In general, steady-state fluid oscillations, especially at higher frequencies, should be analyzed in the frequency domain [5, 30].

Although it is preferable to analyze machines using a distributed parameter analysis, the lumped parameter approach is sometimes very attractive [23, 69], especially in cases in which either the geometry is very irregular and complex or various components of a machine do in fact possess only one dynamic attribute in the frequency range of interest. Lumped parameter analysis has been used successfully in a number of cases [12, 23, 30, 59, 60, 66, 69].

CONCLUDING REMARKS

Part II of this paper discusses applications and such advanced considerations as modeling of turbomachines, coupling of fluid machines, multi-dimensional transients, and two-phase flows [70].

REFERENCES

1. Rich, G., Hydraulic Transients, Dover, NY (1963).
2. Parmakian, J., Waterhammer Analysis, Dover, NY (1963).
3. Pickford, J., Analysis of Surge, McMillan, London (1969).
4. Rudinger, G., Non-Steady Duct Flow: Wave Diagram Analysis, Dover Publications, NY (1969).

5. Goodson, R.E. and Leonard, R.G., "A Survey of Modeling Techniques for Fluid Line Transients," J. Basic Eng., Trans. ASME, 94 (2), pp 474-482 (June 1972).

6. Singh, R. and Soedel, W., "A Review of Compressor Lines Pulsation Analysis and Muffler Design Research. Part I - Pulsation Effects and Muffler Criteria, Part II - Analysis of Pulsating Flows," 2nd Purdue Compressor Tech. Conf. Proc., pp 102-123 (1974).

7. Singh, R. and Soedel, W., "Simulation of Compressor Lines Gas Pulsation," Intl. Congr. Refrigeration, Paper No. B 2-15, Moscow (1975).

8. Streeter, V.L. and Wylie, E.B., "Waterhammer and Surge Control," Ann. Rev. Fluid Mech., 6, pp 57-73 (1974).

9. Streeter, V. and Wylie, E., Hydraulic Transients, McGraw-Hill, NY (1967).

10. Martin, C.S., "Status of Fluid Transients in Western Europe and the United Kingdom, Report on the Laboratory Visits by Freeman Scholer," J. Fluid Engr., Trans. ASME, 95 (1), pp 301-318 (1973).

11. Fox, J.A., Hydraulic Analysis of Unsteady Flow in Pipe Networks, John Wiley, NY (1977).

12. Wylie, E.B. and Streeter, V.L., Fluid Transients, McGraw-Hill, NY (1978).

13. Wylie, E.B., Streeter, V.L., and Stoner, M.A., "Unsteady Natural Gas Calculations in Complex Piping System," J. Soc. Petroleum Engr., pp 35-43 (Feb 1974).

14. Benson, R.S., "Research Note: A Simple Algorithm for a Multi-Pipe Junction in Non-Steady Homentropic Flow," J. Mech. Engr. Sci., 17 (1) (1975).

15. MacLaren, J.F.T., Tramschek, A.B., Pastrana, O.F., and Sanjines, A., "Solving the Equations for Unsteady Gas Flow by Two Methods," Simulation, 2, pp 49-55 (Feb 1976).

16. Gorton, R.L., "Application of Finite Difference Methods to Transient Steam Flow Problems in Power Plant Piping Systems," Transients and Acoustics in Power Industry, ASME, pp 25-30 (1978).

17. Yow, W., "Numerical Error in Natural Gas Transient Calculations," ASME Paper 72-FE-26 (Mar 1972).

18. Streeter, V.L., "Unsteady Flow Calculations by Numerical Methods," ASME Paper No. 71-WA/FE-13 (1971).

19. MacLaren, J.F.T., Tramschek, A.B., Sanjines, A., and Pastrana, O.F., "A Comparison of Numerical Solutions of the Unsteady Flow Equations Applied to Reciprocating Compressor Systems," J. Mech. Engr. Sci., 17 (5) (1975).

20. MacLaren, J.F.T., Tramschek, A.B., Pastrana, O.F., and Sanjines, A., "Research Note: An Alternative Scheme to Solve the Equations for Unsteady Gas Flow," J. Mech. Engr. Sci., 18 (3), pp 161-163 (1976).

21. Cheng, L.C. and Bowyer, J.M., "TUBE-Transient Compressible Flow Code," Transients and Acoustics in Power Industry, ASME, pp 31-35 (1979).

22. Iberall, A.S. and Schindler, A.M., "Linear and Nonlinear Compressible Flow Characteristics," ISA Paper No. 1-7-77, Symp. Flow, Pittsburgh, PA (May 1971).

23. Soedel, W., Gas Pulsations in Compressor and Engine Manifolds, Short Course Text, Purdue Univ. (1978).

24. Sidell, R., "Design and Simulation of Pneumatic Transmission Systems for Frequency Modulated Signals," Ph.D. Thesis, Massachusetts Institute of Technology (1972).

25. Goodson, R.E., "Distributed System Simulation Using Infinite Product Expansions," Simulation, 15 (6) (Dec 1970).

26. Yao, H., "State Space Representations of Distributed Fluid Line Dynamics," Ph.D. Thesis, Purdue Univ. (Jan 1972).

27. Abe, T., Fujikawa, T., and Ito, S., "A Calculating Method of Pulsation in a Piping System," Bull. JSME, 13 (59), pp 678-687 (1970).

28. Funk, J.E., Wood, D.J., and Chao, S.P., "The Transient Response of Orifices and Very Short Lines," ASME Paper No. 71-WA/FE-14 (1971).

29. Astleford, W.J., Holster, J.L., and Gerlach, C.R., "Analysis of Propellent Feedline Dynamics," Project No. 02-2889, Southwest Res. Inst., San Antonio, TX (1972).

30. Doebelin, E.O., System Modeling and Response: Theoretical and Experimental Approaches, Prentice Hall, NY (Summer 1980).

31. Kandelman, A. and Nelson, D.J., "Simplified Model Eases Hydraulic System Simulation," Control Engr., pp 65-66 (Apr 1978).

32. Karam, J.T., Jr., "A Simple But Complete Solution for the Step Response of a Semi-Infinite, Circular Fluid Transmission Line," ASME Paper No. 71-WA/FE-10 (1971).

33. Kantola, R., "Transient Response of Fluid Lines Including Frequency Modulated Inputs," ASME Paper No. 70WA/F1cs-1 (1970).

34. Chaudhry, M.H., "Resonance in Pressurized Piping System," ASCE J. Hydraulics Div., 96 (HY9), pp 1819-1839 (Sept 1970).

35. Sidell, R.S. and Wormley, D.N., "An Efficient Simulation Method for Distributed-Lumped Fluid Networks," ASME 7G-WA/F1cs-1 (1976).

36. Ehrlich, L.W., "Digital Simulation of a Periodic Fluid Flow in a Bifurcation," Computers and Fluids, 2 (3/4), pp 237-247 (1974).

37. Hillman, H.F., Kerkam, B.F., and Poel, G.D., "Application of Linearized Friction Impedance Models to Complex Fluid Systems," J. Fluids Engr., Trans. ASME, pp 189-196 (1973).

38. Benson, R.S. and Ucer, A.S., "An Approximate Solution for Non-Steady Flows in Ducts with Friction," Intl. J. Engr. Sci., 13 (1971).

39. Scarton, H.A. and Roubau, W.T., "Axisymmetric Waves in Compressible Newtonian Liquids Contained in Rigid Tubes: Steady-Periodic Mode Shapes and Dispersion by the Method of Eigen-Values," J. Fluid Mech., 58 (3), pp 595-621 (1973).

40. Scarton, H.A., "Waves and Stability in Viscous and Inviscid Compressible Liquids Contained in Rigid and Elastic Tubes by the Method of Eigenvalues," Ph.D. Thesis, Carnegie-Mellon Univ. (Feb 1970).

41. Singh, R. and Soedel, W., "Assessment of Fluid-Induced Damping in Refrigeration Machinery Manifolds," J. Sound Vib., 57 pp 449-452 (1978).

42. Mercier, O.L. and Wright, D., "A Dynamic Modeling Method of Unsteady Flows in Long Fluid Lines with Turbulent Bulk Velocities," J. Fluids Engr., Trans. ASME, pp 459-466 (1973).

43. Margolis, D.L. and Brown, F.T., "Measurement of the Propagation of Long Wavelength Disturbances through Turbulent Flow in Tubes," J. Fluids Engr., Trans. ASME, pp 70-78 (1976).

44. Thomas, L.C. and Min, J., "An Experimental and Theoretical Study of Transitional Turbulent Pulsatile Flow in a Channel," ASME Paper No. 76-APM-MM (1976).

45. Franke, M.E. and Moore, E.F., "Comparison of the Linear Response of Circular, Rectangular, and Annular Pneumatic Transmission Lines," Proc. Harry Diamond Labs. Fluidic State-of-the-Art Symp., 4, pp 255-268 (1974).

46. Moore, E.F., Karam, J.T., Jr., and Franke, M.E., "A Transient Response Approximation for Noncircular Fluid Transmission Lines," J. Fluids Engr., Trans. ASME, 98 (2), pp 244-248 (June 1976).

47. Franke, M.E. and Moore, E.F., "Dynamic Response Approximation for Noncircular Fluid Lines," ASME Paper No. 76-WA/F1cs-2 (1976).

48. Moore, E.F., "A Transient Response Approximation for Noncircular Fluid Transmission Lines," J. Fluids Engr., Trans. ASME, pp 244-248 (1976).

49. Healey, A.J. and Nicholson, J.A., "Dynamic Characteristics of Annular Fluid Transmission Lines," J. Fluids Engr., Trans. ASME, 96, pp 337-383 (1974).

50. Throley, A.R.D. and Guymer, C., "Pressure Surge Propagation in Thickwalled Conduits of Rectangular Cross Section," ASME Paper 75-WA/FE-15 (1975).

51. Foster, K. and Carley, J.B., "Analysis of Branched Pneumatic Transmission Lines Employed in High Frequency External Feedback Oscillators," Paper H3, Proc. Fourth Cranfield Fluidic Conf. (1970).

52. Franke, M.E., Malanowski, A.J., and Martin, P.S., "Effects of Temperature, End Conditions, Flow, and Branching on the Frequency Response of Pneumatic Lines," ASME Paper 71-WA/Aut-5 (1971).

53. Ravindran, V.K. and Manning, J.R., "The Frequency Response of Pneumatic Lines with Branching," J. Dyn. Syst., Meas. and Control, Trans. ASME, pp 194-196 (1973).

54. MacLaren, J.F.T., Trmaschek, A.B., and Pastrana, O.F., "A Study of Boundary Conditions Encountered in Reciprocating Compressor Systems," Proc. 3rd Purdue Compressor Tech. Conf., pp 33-41 (1976).

55. Parrott, T.L., "An Improved Method for Design of Expansion Chamber Mufflers with Application to an Operational Helicopter," NASA, TN D-7309 (Oct 1973).

56. Sullivan, J.W., "Modeling of Engine Exhaust System Noise," Noise and Fluids Engineering, ASME, pp 161-169 (1977).

57. Galaitsis, A.G. and Bender, E.K., "Measurement of the Acoustic Impedance of an Interval Combustion Engine," J. Acoust. Soc. Amer., S (1), p 58 (1975).

58. Alfredson, R.J., "The Design and Optimization of Exhaust Silencers," Ph.D. Thesis, Univ. Southampton (1970).

59. Davidson, L.C., "The Internal Impedance of Centrifugal and Positive Displacement Pumps," Noise and Fluids Engineering, ASME (1977).

60. Mutyala, B.R.C. and Soedel, W., "A Mathematical Model of Helmholtz Resonator Type Gas Oscillation Discharges of Two-Stroke Cycle Engines," J. Sound Vib., 44, pp 479-491 (1976).

61. Singh, R. and Soedel, W., "Mathematical Modeling of Multicylinder Compressor Discharge System Interactions," J. Sound Vib., 63, pp 125-143 (1979).

62. Karnopp, D.C., Dwyer, H.A., and Margolis, D.L., "Computer Prediction of Power and Noise for Two-Stroke Engines with Power Tuned, Silenced Exhausts," SAE Paper No. 750708 (1975).

63. Singh, R., Sandgren, E., Ragsdell, K., and Soedel, W., "Simulation of a Two Cylinder Compressor for Discharge Gas Oscillation Prediction," ASME Winter Ann. Mtg., ASME Paper No. 76-WA/FE-10 (1976).

64. Singh, R., "Modeling of Multicylinder Compressor Discharge Systems," Ph.D. Thesis, Purdue University (1975).

65. Brennen, C. and Acosta, A.J., "The Dynamic Transfer Function for a Cavitating Inducer," ASME Paper No. 75-WA/FE-16.

66. Von Nimitz, W.W., "Reliability and Performance Assurance in the Design of Reciprocating Compressor Installations. Part I - Design Criteria, Part II - Design Technology," Purdue Compressor Tech. Conf., Proc., pp 329-346 (July 1974).

67. Wright, E.J. and Mufti, I.H., "Simulation of Unsteady Fluid Flow Systems Using a Hybrid Computer," Summer Computer Simulation Conf., Simulation Councils, Inc., P.O. Box 2228, La Jolla, CA 92037 (1975).

68. Touber, S. and Blosnsana, E.C., "Theoretical and Experimental Investigation of Valve Movement and Instationary Gas Flow in a Reciprocating Compressor," IIR, Proc. 13th Intl. Congr. Refrigeration, Washington, pp 595-605 (1971).

69. Singh, R. and Soedel, W., "Interpretations of Gas Oscillations in Multicylinder Fluid Machinery Manifolds by Using Lumped Parameter Descriptions," J. Sound Vib., 64 (3), pp 387-402 (1979).

70. Singh, R., "Fluid Transients in Machines. Part II: Advanced Considerations," Shock and Vib. Dig., to be published (1980).

BOOK REVIEWS

HANDBOOK OF NOISE AND VIBRATION CONTROL

4th Edition; Trade & Technical Press Ltd., Surrey, England, 1979

This large format book contains a vast amount of information in nine chapters and 67 subchapters. The subchapters cover a broad range of topics including psychoacoustics, hearing conservation, hydraulic system noise, audiometry, sound absorption, vibration isolation criteria, auditoria, road traffic noise, legal aspects of noise, and standards. In addition, and probably very important to the authors, is a buyers guide and an advertisers index. The guide and index are supplied because this book contains a significant amount of advertising. (The locations of the firms for noise control products and services are in England, so that this aspect is not especially useful for readers in other countries.)

Unfortunately, there are serious problems with this volume. It is very poorly edited and proofread, and lacks critical explanations of detail. Furthermore, most of the figures are too small to be useful, and few citations are given to other works.

Considering that this is the fourth edition of the book, I wonder why many of the terms in equations have no arithmetical symbols between them, why there is a constant interchange between the letter "l" and the number "1", why subscripts often are on the same line as the subscripted symbol, and why many of the equations are laid out so poorly.

Explanation and discussion are lacking about many points that I feel are important. For example, in such a book, any treatment about combining sound levels should at least allude to the possibility that two sources are coherent. When graphs are introduced as convenient solutions, they should be explained and be easy to read. Definitions as given in the book can confuse the reader. An example of an equation that has two definitions is the formula for noise pollution level in which Leq is defined as both the equivalent (sone) level and the long term average noise levels.

Some of the charts and tables shown deserve a full page treatment. Instead they have been reduced to a fraction of a page, so that the amounts of information given could be compared to integrated circuits. The charts and tables are hard to read and thus can easily be used incorrectly. My main argument with the authors' use and choice of figures, however, is that many contain much more information than is called for in the text.

At least 42 persons or corporations are acknowledged, but the authorship of the chapters is not provided, and no editor is cited. Hence, the reputation of the author cannot be used as one measure of the accuracy and thoroughness of coverage of the subject matter.

There is a lot of information in this book and it does have a relatively complete index. It might therefore be useful as a reference, but, because of the omissions, errors, and poor layout, the book must be used with care and not as a single source for acoustical information.

R.J. Peppin
5012 Macon Road
Rockville, Maryland 20852

SYSTEM DYNAMICS

Katsuhiko Ogata
Prentice-Hall, Inc., Englewood Cliffs, NJ, 1978

The book, which is addressed to junior engineering students, presents a comprehensive treatment of the dynamics of physical systems in several media. It is well-organized, well-written, and interesting to read.

Chapter 1 provides an introduction to and a framework for the textbook through definitions and descriptions of dynamic systems, modeling procedures, model evaluation, analysis and design techniques, and statement of objectives.

Chapters 2-5 are concerned with mathematical modeling and response analysis of mechanical, electrical, hydraulic, and pneumatic systems, respectively. Following an introduction, each chapter defines appropriate units of measurements, which are supplemented by appendices on systems of units and conversion tables. Definitions and descriptions of concepts, basic elements, and laws required in the formulation of mathematical models are presented, as are modeling techniques and analysis procedures. The relative merits of the dynamic systems are discussed. Each chapter is concluded with an extensive selection of example problems with solutions and problems for assignment.

Chapter 6 presents the Laplace transform method. It includes reviews of complex numbers, variables, and functions.

Chapter 7 deals primarily with the transient and steady-state response analyses of linear systems. (Linearization techniques for nonlinear systems are presented in Chapters 4 and 5.) Laplace transform methods are used as a major tool in the analyses.

Chapter 8 presents an introduction to control systems analysis. Included are discussions on automatic controllers; standard techniques for obtaining various control actions through the use of pneumatic, hydraulic, and electronic components; transient response analyses of control systems; and a design problem. As in Chapters 6 and 7, many example problems with solutions and problems for assignment are presented.

Siegfried M. Holzer
Department of Civil Engineering
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061

COMPUTATIONAL TECHNIQUES FOR INTERFACE PROBLEMS

K.C. Park and D.K. Gartling, Editors
AMD-Vol. 30, ASME; New York, NY, 1978

This book contains papers describing computational approaches for moving boundary and interface problems. Such traditional topics as phase changes, free surface problems, and contact problems of flexible bodies are discussed. Brief summaries of the papers contained in this book follow.

In "Conduction and Natural Convection Heat Transfer in a Phase Change Region," A.S. Kushner and W.H. Walston, Jr. discuss the Galerkin finite element solution of heat transfer by conduction in the solid phase and by conduction and natural convection in the liquid phase. A synthesized phase boundary method is utilized in order to work with a fixed finite element mesh consisting of linear triangular ring elements. The effect of the latent heat of fusion along the moving phase boundary is expressed as a nonlinear vector. The vector is an implicit function of the nodal point temperatures at the beginning and end of the time interval over which the temperature change is evaluated. The solutions for heat transfer in the solid and liquid regions are coupled so that the phase boundary motion can be located.

"Finite Element Simulation of Two-Phase Flows Porous Media" by P.S. Huyakorn, G.F. Pinder, C.R. Faust, and J.W. Mercer demonstrates the advantage of using the upwind finite elements in place of the traditional Galerkin finite elements in the solution of two-phase flows in porous media. The authors arbitrarily avoid upwind functions for the time-dependent term and use the Galerkin form instead. The result is a conventional gram matrix for the time-dependent term. Although the computational results appear to be reasonable, the mathematical basis for the formulation is not clear.

A mixed Eulerian-Lagrangian formulation with the interior treated as Eulerian and the free surfaces as Lagrangian is shown for imcompressible fluid flows with multiple free surfaces in "Calculation of Three-Dimensional Fluid Flow with Multiple Free Surfaces" by M.J.V. Vorst and R.K.C. Chan. The Laplace equation for the potential is solved at interior points of

the Eulerian finite difference mesh. The Lagrangian free surfaces are composed of triangular elements for the fully nonlinear Bernoulli equation. The method is applied for the three-dimensional flow in a Mark I reactor pressure suppression system immediately following a postulated loss-of-coolant accident.

"Prediction Atmospheric Flows on Nested Grids" by R.L. Elsberry deals with some aspects of the interface problem for nested grid meteorological models. Various spatial lattices, vertical coordinate systems, and space-and-time differencing schemes are used.

"Mathematical Modeling of Ablatian Problems" by B. Laub, K.E. Suchsland, and A.L. Murray describes computational techniques for modeling material recession history and in-depth thermal field. Temperature and density histories of a thermally decomposing material exposed to a high-temperature environment that can chemically erode the material surface are calculated using finite difference techniques.

In "A Numerical Treatment of Sliding Interfaces and Impact" by J.O. Hallquist, finite differences and finite elements are utilized for sliding interfaces. The author claims that the excitation of zero energy mesh distortions present no problem even when pressures are in the hundreds of kilobars.

Variational inequalities and Green's operators are used to formulate contact problems in elasticity in "A Class of Signorini's Problems by Reciprocal Variational Inequalities" by N. Kikuchi. The problems are solved by finite elements. The contact surface can be determined as a part of the solution using optimization methods.

J.B. Newan shows in "Calculation of Mechanical Interactions Affecting Length and Diameter Changes in Nuclear Reactor Fuel Rods" that the results of the interaction computations for length and diameter changes in nuclear reactor fuel rods must be checked to assure consistency with the assumed interaction state.

In "An Improved Numerical Method and Computer Program for Counterformal Contact Stress Problems," B. Paul and J. Hashemi develop efficient methods for solving frictionless counterformal contact stress problems. Candidate contact boundary curves are modified and automatically overlaid with appropriately defined networks of cell boundaries. Non-Hertzian problems are solved and interesting numerical examples are given.

T.J. Chung
Professor and Chairman
Department of Mechanical Engineering
University of Alabama
Huntsville, Alabama

SHORT COURSES

JUNE

MACHINERY VIBRATION ANALYSIS SEMINARS

Dates: June 17-18, 1980
Place: Oak Brook, Illinois
Dates: July 9-10, 1980
Place: New Orleans, Louisiana
Dates: August 12-13, 1980
Place: Sheraton Inn-Newark Airport, NJ
Dates: October 1-2, 1980
Place: Houston, Texas

Objective: These two day seminars on machinery vibration analysis will be devoted to the diagnosis and correction of field vibration problems. The material is aimed at field engineers. The sessions will include lectures on the following topics: basic vibrations; critical speeds, resonance; torsional vibrations; instrumentation, including transducers, recorders, analyzers, and plotters; calibration; balancing and vibration control, identification of unbalance, misalignment, bent shafts, looseness, cavitation, and rubs; advanced diagnostic techniques, identification of defects in gears and antifriction bearings by spectrum analysis, and correction of structural foundation problems.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 (312) 654-2254/654-2053.

BLASTING AND EXPLOSIVES SAFETY TRAINING

Dates: June 18-20, 1980
Place: Tucson, Arizona
Dates: September 10-12, 1980
Place: Atlantic City, New Jersey
Dates: September 24-26, 1980
Place: Des Moines, Iowa
Dates: October 8-10, 1980
Place: Nashville, Tennessee
Dates: October 22-24, 1980
Place: Casper, Wyoming
Dates: November 5-7, 1980
Place: Hershey, Pennsylvania

Objective: This course is a basic course that teaches safe methods for handling and using commercial explosives. We approach the problems by getting at the reasons for safety rules and regulations. Helps provide blasters and supervisors with a practical understanding of explosives and their use - stressing importance of safety leadership. Familiarizes risk management and safety personnel with safety considerations of explosives products and blasting methods.

Contact: E.I. du Pont de Nemours & Co. (Inc.), Applied Technology Division, Wilmington, DE 19898 - (302) 772-5982/774-6406.

MACHINERY VIBRATION ANALYSIS

Dates: June 18-20, 1980
Place: Houston, Texas
Dates: August 26-28, 1980
Place: Las Vegas, Nevada
Dates: December 10-12, 1980
Place: New Orleans, Louisiana

Objective: The course covers causes, effects, detection, and solutions of problems relating to rotating machines. Vibration sources, such as oil and resonant whirl, beats, assembly errors, rotor flexibility, whip, damping, eccentricity, etc. will be discussed. The effect on the overall vibration level due to the interaction of a machine's structure, foundation, and components will be illustrated.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

DYNAMICS OF STRUCTURAL AND MECHANICAL SYSTEMS

Dates: June 23-27, 1980
Place: UCLA

Objective: For engineers interested in the presentation of the area of structural dynamics at an intermediate level with application to aerospace, civil

and mechanical engineering. The course presents the area of structural dynamics at an intermediate to advanced level. The subject is treated in a unified manner so as to be equally applicable to aerospace, civil and mechanical engineering problems. The course emphasizes discrete methods, numerical methods and structural modeling for computer-oriented solution of various structural dynamic problems. Some recent developments in the structural dynamic analysis of parametrically excited systems, rotating systems and systems in which fluid-structure dynamic interactions occur are also considered.

Contact: Continuing Education in Engineering and Mathematics, P.O. Box 24901, UCLA Extension, Los Angeles, CA 90014 - (213) 825-3344/825-1295.

MACHINERY VIBRATIONS SEMINAR

Dates: June 24-26, 1980
Place: Mechanical Technology, Inc.
Latham, New York
Objective: To cover the basic aspects of rotor-bearing system dynamics. The course will provide a fundamental understanding of rotating machinery vibrations; an awareness of available tools and techniques for the analysis and diagnosis of rotor vibration problems; and an appreciation of how these techniques are applied to correct vibration problems. Technical personnel who will benefit most from this course are those concerned with the rotor dynamics evaluation of motors, pumps, turbines, compressors, gearing, shafting, couplings, and similar mechanical equipment. The attendee should possess an engineering degree with some understanding of mechanics of materials and vibration theory. Appropriate job functions include machinery designers; and plant, manufacturing, or service engineers.

Contact: Mr. Paul Babson, MTI, 968 Albany-Shaker Rd., Latham, NY 12110 - (518) 785-2371.

ADVANCED DYNAMIC ANALYSIS FOR MODAL TESTING USERS

Dates: June 25-26, 1980
Place: San Diego, California
Dates: July 9-10, 1980
Place: Cincinnati, Ohio
Objective: This seminar has been organized to provide the serious user (advanced and beginner alike) with a complete knowledge of the capabilities and applications of the SDRC Testing Software Package (MODAL, MODAL-PLUS, SABBA and FATIGUE). The emphasis will, therefore, be on advanced software capabilities and their use to solve dynamics problems. Applications will come from the vehicle, construction and mining equipment, and rotating equipment areas; but, will be of general interest to any engineer working in the area of experimental dynamics.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

JULY

GEAR NOISE

Dates: July 1-2, 1980
Place: Ohio State University
Objective: The course will cover general noise measurements and analysis, causes of gear noise, dynamic modeling, gear noise signal analysis, and modal analysis of gear boxes. Problems of course attendees will be discussed in a special workshop session. Laboratory demonstrations will also be given.

Contact: Mr. Richard Frasher, Director, Continuing Education, College of Engineering, Ohio State University, 2070 Neil Avenue, Columbus, OH 43210 - (614) 422-8143.

INDUSTRIAL PRODUCT NOISE CONTROL

Dates: July 7-11, 1980
Place: Schenectady, New York
Objective: Designed for engineers, designers, environmental health specialists, and managers concerned with noise and vibration control. The course will provide information on the theory, measurement, and economics of noise reduction. It will cover the latest information on the nature of sound and noise control, including noise criteria, airborne sound distribution, vibration control, and noise signature analysis. Other topics include how noise is produced by different types of engineering equipment such as compressors, electric motors, fans, valves, and transformers.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

PLANNING A DIGITAL DATA ACQUISITION AND CONTROL COMPUTER SYSTEM

Dates: July 9-11, 1980

Place: Schenectady, New York

Objective: Will deal with the interconnection of a multitude of devices from sensors to final control elements with ultimate output of system conditions on the man-machine interface devices; the sensing of temperature, pressure, level, flow, speed, weight, torque, vibration and electrical parameters such as: volts, amps, watts, vars, power factor, frequency, and motor load. The flexibility and utilization of data presentation via dynamic, colored graphic and tabular CRT displays will be presented as an optimum man-machine interface. System components/hardware and their interconnection will be discussed in depth. Staging, on-site testing, and as-built documentation will be the final steps in planning a digital acquisition and control computer system.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

FRACTURE MECHANICS I AND ITS APPLICATION TO ENGINEERING DESIGN

Dates: July 14-18, 1980

Place: Schenectady, New York

Objective: Material covered in "Fracture Mechanics I" will benefit anyone in an engineering related position who is concerned with the application of fracture mechanics to the prevention of brittle fracture such as pressure vessels for power generation, malleable iron castings, structural steel fabricated frameworks, and ASME Pressure Vessel code applications. Included are the engineering approach to component failure; failure analysis of pressure vessels; fracture mechanics based toughness criteria in ASME Pressure Vessel code; examples and case histories of code fracture mechanics applications; elastoplastic analysis; computer aids for calculating remaining cyclical life; crack initiation and propagation; life prediction; and non-destructive testing methods and capabilities.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

APPLIED INSTRUMENTATION AND MEASUREMENTS ENGINEERING

Dates: July 14-18, 1980

Place: Schenectady, New York

Objective: Designed for technicians, engineers, and managers involved in the field of instrumentation and measurements. It will present a comprehensive view of the instrumentation system from transducer to readout, including a major emphasis on computer interfacing techniques. Principal topics will include: philosophy of measurements, transducer operating principles and selection criteria, static and dynamic data acquisition systems, occurrence and prevention of noise in measurement systems, data reduction methods, digital techniques, and statistical treatment of data. "Hands-on" lab experience will be offered.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

INTRODUCTION TO THE VIBRATION AND STRESS ANALYSIS OF PRESSURE ACTUATED VALVES FOR GAS COMPRESSORS USING FINITE ELEMENT METHODS

Dates: July 21-22, 1980

Place: Purdue University

Objective: The course content is general to many fluid machinery systems utilizing pressure actuated flexible valves, however, class examples will emphasize small, high-speed, refrigerant compressors. Interest is directed to the development of suitable mathematical models for the prediction of the dynamic motion of the flexible valve during the compressor cycle and the resultant stress field in the valve. Participants should be familiar with the mathematical simulation philosophy for compressors. Extension of the valve modeling to more detailed descriptions compatible with the general compressor simulation will be presented.

Contact: James F. Hamilton, Ray W. Herrick Laboratories, School of Mech. Engrg., Purdue University, West Lafayette, IN 47907.

PROBABILISTIC ANALYSIS OF VIBRATIONS

Dates: July 21-23, 1980

Place: Irvine, California

Objective: Topics include: fundamentals of probability theory, response of one degree of freedom systems; cross correlation and cross spectral density of force and response; several random point forces, random distributed forces; joint acceptance functions; coherence functions and their application; probability distribution of stress, fatigue; statistical energy analysis; applications in aeronautical engineering; applications in mechanical engineering; applications in civil engineering.

Contact: Computation Mechanics, P.O. Box 4174, Irvine, CA 92716

FRACTURE MECHANICS II WITH INDUSTRIAL APPLICATIONS

Dates: July 21-24, 1980

Place: Schenectady, New York

Objective: Designed for engineers with responsibility and management of fracture analysis and prevention. Some knowledge of fracture mechanics is assumed, since this course represents advanced, "state-of-the-art" fracture mechanics as applied in the pressure vessel and piping fields. Major topics are: fundamental concepts; estimation of plastic zone size; "J" integral and methods for estimation; fundamentals and computer applications of finite element methods to notches and cracks; special topics in advanced analytical methods; selected applied industrial problems; metallurgical aspects of high toughness materials; residual stresses; service environment; "state-of-the-art" in testing for use of small specimens; finite element applications; and elasto-plastic fracture toughness - "R" curves.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

FINITE ELEMENT METHOD IN MECHANICAL DESIGN

Dates: July 21-25, 1980

Place: University of Michigan

Objective: The course is intended for engineers working in mechanical design or analysis where knowledge of stresses, displacements or vibration is required. No previous experience with finite elements is assumed. The course will reveal the fundamentals on which the method is based and will familiarize the attendee with modeling concepts. A number of practical examples will be presented. Laboratory work will be emphasized and each attendee will be encouraged to create his own finite element models of simple mechanical systems. Topics include: historical review, technical review, line element, assembly of elements, constant strain triangle, virtual work derivation of general equations, equation solvers, natural coordinates and isoparametric elements, heat conduction element, plate and shell element, and general purpose computer programs.

Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI 48109 - (313) 764-8490.

COMPUTER WORKSHOP IN EARTHQUAKE AND STRUCTURAL DYNAMICS

Dates: July 28 - August 1, 1980

Place: Schenectady, New York

Objective: This course will cover structural dynamics techniques for both linear and nonlinear many-degree-of-freedom systems. Special emphasis will be given to seismic applications such as NRC requirements. Random vibration methods will be presented, and response spectrum methods for many-degree-of-freedom systems will be given. In addition, a nonlinear dynamics computer program, as well as eigenvalue and sinusoidal analysis programs, will be available for workshop use. Listings of these programs and relative merits of ANSYS, SAP, and ADINA programs will be discussed. Computer graphics for input generation and output presentation, as well as applications to current technological problems will be given, including earthquake analysis, pipe whip dynamics, shock response of electronic cabinets, fluid-solid interaction, and self-excited vibrations of a multimodal structure. FORTRAN computer programs will be presented for multi-degree-of-freedom systems, and will be applied to tutorial and student generated problems.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

COMPUTER WORKSHOP IN FINITE ELEMENT METHODS OF ANALYSIS FOR STRESS AND OTHER FIELD PROBLEMS

Dates: July 28- August 1, 1980
Place: Schenectady, New York
Objective: This course will cover finite element techniques for 2D and 3D structural analysis and dynamics. Both 2D and 3D programs, including listings, will be available for student use. Generalization of finite element methods to heat transfer and fluid flow will be given with programs in each discipline. In addition, incremental loading into the plastic range and finite element methods in fracture mechanics will be presented. Relative merits of ANSYS, SAP, ADINA, and other programs will be discussed, and computer graphics for input generation and output presentation will be given. Applications to current technological problems will include thermal and stress analysis of nuclear vessel nozzle, 3D pipe intersection, turbine blade application, and water mass of nuclear fuel channels. FORTRAN IV computer programs for both 2D and 3D problems will be presented and applied to tutorial and student generated problems.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

AUGUST

FINITE ELEMENT ANALYSIS IN FLUID DYNAMICS

Dates: August 4-8, 1980
Place: Knoxville, Tennessee
Objective: This course is designed to familiarize the engineer/scientist with the basic concepts and practice of finite element methodology; to detail step-by-step numerical solutions for elementary but highly informative ideal flows; to extend these developments to nonlinear problems, building directly upon introductory concepts; to expose the important aspects of the mathematical theory and make detailed comparison to conventional procedures; to expand applications to turbulent and compressible flows over a range of Mach and Reynolds numbers; and to introduce and correlate the newest developments including tensor products, optimal control, constrained optimization.

Contact: Eunice Hinkle, Department of Engineering Science and Mechanics, University of Tennessee, 317 Perkins Hall, Knoxville, TN 37916 - (615) 974-2171.

NOISE ANALYSIS

Dates: August 6-7, 1980
Place: Cincinnati, Ohio
Objective: This seminar will provide engineers concerned with noise analysis and control an introduction to the most current technology in this area. The session will be dedicated to presenting the latest noise analysis procedures, and the various noise control measures which can be employed, primarily related to product noise. Topics discussed will include: physical acoustics, psycho-acoustics, time series analysis, source identification, structural frequency response, noise control, absorption, barriers, isolation, stiffening, and damping.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

FATIGUE ANALYSIS

Dates: August 13-14, 1980
Place: San Diego, California
Dates: September 10-11, 1980
Place: Cincinnati, Ohio
Objective: The growing understanding of the important factors in the fatigue failure process coupled with the accumulation of new, correctly obtained, fatigue test data and material property and behavior data, has led to the practical application of fatigue analysis methods. The vast improvements in stress analysis, both computerized design analysis (finite element methods, etc.) and experimental testing techniques (digital Fourier analysis, cycle counting methods, etc.) have enabled engineers and designers to get a more fundamental understanding of fatigue. The seminar will address the topics of cyclic stress-strain behavior of metals, fatigue properties of metals and cumulative damage procedures.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

PYROTECHNICS AND EXPLOSIVES

Dates: August 18-22, 1980

Place: Philadelphia, Pennsylvania

Objective: The seminar combines the highlights of "Pyrotechnics and Solid State Chemistry," given the last eleven summers, and "Explosives and Explosive Devices" that made its successful appearance nine years ago. Similar to previous courses, the seminar will be practical so as to serve those working in the field. Presentation of theory is restricted to that necessary for an understanding of basic principles and successful application to the field. The seminar will be welcomed both by newcomers to the field as well as by experienced men who wish to brush up on latest developments. Coverage emphasizes recent effort, student problems, new techniques, and applications. The prerequisite for this seminar is a bachelor of science degree in engineering or equivalent.

Contact: Mr. E.E. Hannum, Registrar, The Franklin Research Center, Philadelphia, PA 19103 - (215) 448-1236/1395.

HIGH-SPEED COMPUTATION: VECTOR PROCESSING

Dates: August 18-22, 1980

Place: University of Michigan

Objective: In this course, the architectural, software, and algorithmic issues are covered by (a) background discussions of formal theory of parallel and vector algorithms with applications, and (b) presentations on four current vector processors and their application to large scientific and engineering problems. The course will consist of lectures and informal laboratory sessions with counseling. Three major vector processors - the Burroughs BSP, the Control Data CYBER 203, and the Cray Research CRAY-1 - are all available for benchmarking for the first time. Arrangements have been made to have both remote, high-speed access and site counselors from the processor manufacturers. The serious student should have adequate access to all of the processors to achieve at least local vectorization of small FORTRAN programs and to invoke special vector constructs and available mathematical software (equation and recurrence solvers, FFT's, etc.).

Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI 48109 - (313) 764-8490.

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: August 25-29, 1980

Place: Santa Barbara, CA

Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and thoery.

Contact: Wayne Tustin, 22 East Los Olivos St., Santa Barbara, CA 93105 - (815) 682-7171.

SEPTEMBER

UNDERWATER ACOUSTICS

Dates: September 8-12, 1980

Place: University Park, Pennsylvania

Objective: This is a concentrated course designed to cover the basic principles of underwater acoustics as well as current research and recent developments in the field. The course is intended to serve as an introductory course for those who are new to the field but have the appropriate educational background; and as a refresher course for scientists, engineers, program managers, and administrators engaged in underwater acoustics. Topics will include: basic acoustics; sonar concepts; ambient noise; reverberation; underwater acoustics transmission; transducer concepts; nonlinear acoustics/parametric arrays; target physics; and flow noise.

Contact: Robert E. Beam, Conference Coordinator, Pennsylvania State University, Faculty Building, University Park, PA 16802 - (814) 865-5141.

9TH ADVANCED NOISE AND VIBRATION COURSE

Dates: September 15-19, 1980

Place: Institute of Sound and Vibration Research, University of Southampton, UK

Objective: The course is aimed at researchers and development engineers in industry and research establishments, and people in other spheres who are

associated with noise and vibration problems. The course, which is designed to refresh and cover the latest theories and techniques, initially deals with fundamentals and common ground and then offers a choice of specialist topics. The course comprises over thirty lectures, including the basic subjects of acoustics, random processes, vibration theory, subjective response and aerodynamic noise, which form the central core of the course. In addition, several specialist applied topics are offered, including aircraft noise, road traffic noise, industrial machinery noise, diesel engine noise, process plant noise, and environmental noise and planning.

Contact: Mrs. O.G. Hyde, ISVR Conference Secretary, The University of Southampton, S09 5NH UK-Southampton (0703) 559122, Ext. 2310 or 752, Telex: 47661.

MODAL ANALYSIS

Dates: September 17-19, 1980
Place: Cleveland, Ohio
Objective This seminar will provide information on new techniques for identifying dynamic structural weaknesses. The sessions include the use of state-of-the-art instrumentation and software for creating a dynamic structural model in the computer. Techniques will be demonstrated for mode shape calculation and animated displays, computation of mass, stiffness and damping values and modal manipulation methods.

Contact Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

VIBRATION CONTROL

Dates: September 29 - October 3, 1980
Place Pennsylvania State University
Objective This seminar will be of interest and value to engineers and scientists in industry, government, and education. Topics for consideration include dynamic mechanical properties of viscoelastic materials; structural and constrained-layer damping; isolation of machinery vibration from rigid and nonrigid substructures; isolation of impact transients; reduction of vibration in beams, plates, shells, periodic structures, stiffened plates, and rings and ring segments; and characteristics of multi-resonant vibrators. Each student will receive bound lecture notes and copies of six textbooks for his permanent reference.

Contact: Professor John C. Snowdon, Seminar Chairman, Applied Research Laboratory, Pennsylvania State University, P.O. Box 30, State College, PA 16801.

OCTOBER

VIBRATION TESTING

Dates: October 6-9, 1980
Place: San Diego, California
Objective: Topics to be covered are: exciters, fixtures, transducers, test specifications and the latest computerized techniques for equalization, control, and protection. Subjects covered include dynamics and dynamic measurements of mechanical systems, vibration and shock specifications and data generation. Demonstrations are given of sine random and shock testing and of how test specifications are met.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

DIGITAL SIGNAL PROCESSING

Dates: October 21-23, 1980
Place: Atlanta, Georgia
Objective: The mathematical basis for the fast Fourier transform calculation is presented, including frequency response, impulse response, transfer functions, mode shapes and optimized signal detection. Convolution, correlation functions and probability characteristics are described mathematically and each is demonstrated on the Digital Signal Processor. Other demonstrations include spectrum and power spectrum measurements; relative phase measurements between two signals; and signal source location.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

NOVEMBER

MACHINERY VIBRATION IV

Dates: November 11-13, 1980
Place: Cherry Hill, New Jersey
Objective: Lectures and demonstrations on vibration measurement rotor dynamics and torsional vibration

are scheduled. General sessions will serve as a review of the technology; included are the topics of machine measurements, modal vibration analysis, and vibration and noise. The rotor dynamics sessions will include: using finite element, transfer matrix, and nonlinear models; vibration control including isolation, damping, and balancing. The sessions on torsional vibration feature fundamentals, modeling measurement and data analysis, self-excited vibrations, isolation and damping, transient analysis, and design of machine systems.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254/654-2053.

NEWS BRIEFS

news on current and Future Shock and Vibration activities and events

VIBRATIONS IN ROTATING MACHINERY
September 2-4, 1980
Cambridge, England

The Second International Conference on "Vibrations in Rotating Machinery" will be held September 2-4, 1980 at Churchill College, Cambridge, England.

The aim of this conference is to report significant progress which has been made these past four years and to enable scientists and engineers to exchange views on recent advances over a wide range of topics.

Emphasis will be on the application of known methods to plant in service, together with the consideration of plant elements, such as glands, which have been less fully considered in the past.

Papers will be presented by authors from Europe, North America, the Far East and Australia. Subject areas will include: Bearings - theoretical treatments, practical observations; Steady State Behavior - forced motion, balancing, effects of defects, effect of supports and foundations; Monitoring - and analysis; Rotor Instability - and transient behavior; Components - blades, gears, labyrinths and seals, couplings; Torsional Vibration, and Gyros.

Technical sessions will be arranged to cover coherent groups of papers broadly representative of the subject areas. There will be approximately 60 papers which will necessitate parallel sessions. These will be ordered as far as possible so as not to present delegates with a conflict of interest.

Prospective delegates are invited to apply to have their names placed on the registration form mailing list. This will ensure early delivery and thus enable them to complete it and submit it promptly for processing by the Conference Secretary.

For further information, contact Mr. R.S. Glynn, Manager - Conferences, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ, England.
01-222 7899 Ext: 203; Telex: 917944

ENGINEERING ASPECTS OF CREEP
September 15-19, 1980
Sheffield, England

"Engineering Aspects of Creep" is the title of this 1980 International Conference being held September 15-19, 1980 at Ranmoor House, University of Sheffield, England.

The aim of this conference is to report significant progress which has been made over the past five years and to enable scientists and engineers to exchange views on recent advances over a wide range of topics.

Emphasis will be on experience with plant in service and with design methods and design criteria which have been found to be satisfactory.

Papers will be presented by authors from Europe, North America and from Far Eastern countries and will deal with the following subject areas:

High Temperature Materials Properties:
with emphasis on new data on existing materials and data on new materials, relating to creep, combined creep and fatigue, fracture, crack propagation and the effect of environment.

Structural Analysis.
calculation techniques for stress analysis including methods such as energy bounds and reference stresses as well as finite elements, finite differences and closed form solutions.

Experience with High Temperature Plant in Different Industries:
including nuclear plant, conventional power station plant, chemical and petro-chemical plant, gas turbines and diesel engines.

In view of the extent of interest, there will be a special session on creep crack propagation. Other sessions will be as follows:

- The Data Base
- Creep-Fatigue

- Extrapolation Models
- Variable Loading, Creep Relaxation
- Crack Propagation
- Design Methodology - Nuclear/Fast Reactor
- Design Methodology - Mainly General
- Plant Experience
- Residual Life

A display area will be provided in Ranmoor House where manufacturers will be afforded the opportunity to display equipment. Companies interested in exhibiting at the Conference should get in touch immediately with Mr. T. Hebden, Deputy Head of Conference Department at The Institution of Mechanical Engineers.

For further information, contact: Mr. R.S. Glynn, Manager - Conferences, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ, England
01-222 7899 Ext: 203; Telex. 917944

EIGHTH VIBRATION CONFERENCE
DESIGN ENGINEERING DIVISION
American Society of Mechanical Engineers

Announcement and Call for Papers

The eighth biennial ASME/DED Conference on Mechanical Vibration and Noise is scheduled to be held as part of the 1981 Design Technical Conference in Hartford, Connecticut on September 20-23, 1981. The Hartford Section of ASME will be host.

The theme of this conference, like the past conferences, will be the applied aspects of vibration engineering in terms of analysis and prediction, to those of noise and vibration control. Emphasis will be on the technology and experience associated with current engineering problems of real apparatus and equipment. In addition, the aspects emerging technologies of analysis and control will also be emphasized.

Technical papers are solicited in the areas indicated below. Abstracts should be submitted to the appropriate subcommittee chairmen on ASME form M&P 1903 by September 15, 1980. Form M&P 1903 is available from:

ASME
345 E. 47th Street
New York, NY 10017
(212) 644-7722

or from the subcommittee chairmen. Overseas contributors may also obtain this form from the appropriate overseas representatives listed below. Abstracts of papers of broad interest or which do not fall into the topic areas listed below should be submitted to the conference chairman.

Complete manuscripts (in quadruplicate) are due by December 15, 1980 to the subcommittee chairmen. Accepted papers will be preprinted for the conference and will also be considered for publication in the Journal of Mechanical Design.

CONFERENCE CHAIRMAN

Professor James F. Hamilton
School of Mechanical Engineering
Purdue University
West Lafayette, IN 47907
(317) 749-6317 or (317) 749-6321

ASSOCIATE CONFERENCE CHAIRMAN

Dr. A.V. Srinivasan
United Technologies Center
Silver Lane
East Hartford, CT 06108
(203) 727-7211 or (203) 727-7000

WORLD REPRESENTATIVES

(Japan) Dr. Akemi Futakawa
Manager of Mech. & Dynamics Dept.
Central Research Laboratories
Mitsubishi Electric Corporation
80 Minamishimizu, Nakano, Amagasaki
Hyogo, Japan 661

(England) Dr. D.J. Mead
Dept. of Aeronautics & Astronautics
The University of Southampton
Southampton S09 5NH
United Kingdom

(Canada) Dr. T.S. Sankar, Chairman
Dept. of Mech. Engineering, H929
Concordia University
1455 de Maisonneuve Blvd. W.
Montreal, Canada H3G 1M8

(India) Dr. V. Ramamurti
Professor, Dept. of Applied Mechanics
Indian Institute of Technology
Madras - 600036/India

(Israel) Dr. Simon Braun
Faculty of Mechanical Engineering
Technion - Israel Inst. of Technology
Technion City, Haifa 32000
Israel

SUBCOMMITTEE TOPICS

Rotating Machinery

Balancing, stability; foundation interaction; crack propagation and fatigue; synchronous and nonsynchronous response; vibration control with damped rotor-bearing systems; torsional vibrations.

Dr. A.V. Srinivasan
United Technologies Center
Silver Lane
East Hartford, CT 06108
(203) 727-7211 or (203) 727-7000

Vibration Reduction and Control

Passive and active vibration isolators; vibration absorbers; design of dampers and damping treatments.

Dr. R.L. Eshleman
The Vibration Institute
Suite 206, 101 W. 55th Street
Clarendon Hills, IL 60514
(312) 654-2254

Structural Dynamics

Advances in solution of vibratory structures; substructure methods; synthesis and/or simulation of vibrating systems; use of calculators and minicomputers.

Dr. Richard D. Rocke
Bldg. 600/D-131
Hughes Aircraft Company
Fullerton, CA 92634
(714) 732-3232, Ext. 4638

Finite Element Sound and Vibration Analysis

Finite element application to real sound and/or vibration problems; novel applications; comparisons and evaluations of accuracy; a collection of finite element applications to acoustic problems is sought to present state of the art.

Dr. J.A. Wolfe, Jr. and Dr. M.M. Kamal
Engineering Mechanics Department
General Motors Research Laboratory
Warren, MI 48090
(313) 575-3357 and (313) 575-2929

Mechanical Signature Analysis

Diagnostic techniques; defect identification; analytical and computational methods; applications to rotating machinery; structural testing; process monitoring; noise abatement.

Dr. Simon Braun
Faculty of Mechanical Engineering
Technion - Israel Institute of Technology
Technion City, Haifa 32000
Israel

Machinery Noise

Prediction methods; control of noise sources; determination of noise paths; coherence and correlation methods; spectral methods; acoustic radiations; techniques for noise reduction of machines and machine components.

Dr. L.L. Faulkner
Battelle - Columbus Laboratories
505 King Avenue
Columbus, OH 43201
(614) 424-5280

Transportation Noise

Engine noise characteristics; engine vibration noise; transmission paths; noise isolation and absorption in vehicles; wheel-rail interaction; tire noise and vibration

Mr. Ralph K. Hillquist
General Motors Proving Grounds
Millford, MI 48042
(313) 685-5162

Recent Development in Acquisition and Analysis of Vibration Data

Acoustic emission; ultrasonic testing; holographic measurements; signal analysis; data reduction via spectral methods; shock response analysis; industrial applications.

Mr. H. Saunders
General Electric Company
Bldg. 41, Room 319
Schenectady, NY 12345
(518) 385-0251

Blade Vibration

Excitation mechanisms; blade and blade group vibration; blade-disc interaction; experimental measurements in stationary and rotating conditions.

Dr. P.M. Niskode
Aircraft Engine Group
M/D K71
General Electric Company
Neumann Way
Cincinnati, OH 45215
(513) 243-4783

Fluid-Structure Interaction

Vortex-induced vibration; flutter; vibration caused by oscillating flows; turbulent buffeting of structures; instabilitites in tube arrays; leakage-flow-induced vibrations; design applications.

Dr. Martin W. Wambsganss
Argonne National Laboratories
Bldg. 335
9700 S. Cass Avenue
Argonne, IL 60439
(312) 972-2000, Ext. 6144

Special Problems in Vibration

Nonlinear system vibration; random vibration; seismic induced vibration; machine tool chatter; statistical energy analysis; impedance methods, etc.

Dr. Andrew F. Seybert
Mechanical Engineering Dept.
University of Kentucky
Lexington, KY 40506
(606) 758-2661

ABSTRACT CATEGORIES

MECHANICAL SYSTEMS

Rotating Machines
Reciprocating Machines
Power Transmission Systems
Metal Working and Forming
Isolation and Absorption
Electromechanical Systems
Optical Systems

STRUCTURAL SYSTEMS

Bridges
Buildings
Towers
Foundations
Underground Structures
Harbors and Dams
Roads and Tracks
Construction Equipment
Pressure Vessels
Power Plants

VEHICLE SYSTEMS

Ground Vehicles
Ships
Aircraft
Missiles and Spacecraft

BIOLOGICAL SYSTEMS

Human
Animal

MECHANICAL COMPONENTS

Absorbers and Isolators
Springs
Tires and Wheels
Blades
Bearings
Belts and Conveyors
Gears
Clutches
Couplings
Fasteners
Linkages
Valves
Seals

STRUCTURAL COMPONENTS

Strings and Ropes
Cables
Bars and Rods
Beams
Cylinders
Columns
Frames and Arches
Membranes, Films, and Webs
Panels
Plates
Shells
Rings
Pipes and Tubes
Ducts
Building Components

ELECTRIC COMPONENTS

Controls (Switches, Circuit Breakers)
Motors
Generators
Transformers
Relays
Electronic Components

DYNAMIC ENVIRONMENT

Acoustic Excitation
Shock Excitation
Vibration Excitation
Thermal Excitation

MECHANICAL PROPERTIES

Damping
Fatigue
Elasticity and Plasticity

EXPERIMENTATION

Measurement and Analysis
Dynamic Tests
Scaling and Modeling
Diagnostics
Balancing

ANALYSIS AND DESIGN

Analogs and Analog Computation
Analytical Methods
Modeling Techniques
Nonlinear Analysis
Numerical Methods
Statistical Methods
Parameter Identification
Mobility/Impedance Methods
Optimization Techniques
Design Techniques
Computer Programs

GENERAL TOPICS

Conference Proceedings
Tutorials and Reviews
Criteria, Standards, and Specifications
Bibliographies
Useful Applications

ABSTRACTS FROM THE CURRENT LITERATURE

Copies of articles abstracted in the DIGEST are not available from the SVIC or the Vibration Institute (except those generated by either organization). Inquiries should be directed to library resources. Government reports can be obtained from the National Technical Information Service, Springfield, VA 22151, by citing the AD-, PB-, or N- number. Doctoral dissertations are available from University Microfilms (UM), 313 N. Fir St., Ann Arbor, MI. U.S. Patents from the Commissioner of Patents, Washington, D.C. 20231. Addresses following the authors' names in the citation refer only to the first author. The list of periodicals scanned by this journal is printed in issues 1, 6, and 12.

ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 1268, 1309, 1330, 1331, 1332, 1348, 1368, 1369, 1408, 1409, 1421, 1433, 1434, 1438, 1439, 1445, 1446, 1447, 1463)

80-1239

Design and Closed Loop Testing of High-Pressure Centrifugal Gas Compressors for the Suppression of Subsynchronous Vibration

A.F. Criqui and P.G. Wendt
Solar Turbines International, An Operating Group of International Harvester, 2200 Pacific Highway, P.O. Box 80966, J. Engr. Power, Trans. ASME, 102 (1), pp 136-140 (Jan 1980) 11 figs, 1 table, 10 refs

Key Words: Rotor-bearing systems, Rotors (machine elements), Critical speeds, Vibration control

The causative phenomena of subsynchronous vibration, or re-excitation of the critical speed of a rotor, are discussed. Two rotor systems designed to control this type of vibration are presented. One system employs tuned, oil film damper bearings while the other features a stiffened rotor geometry. Stability thresholds of each design are compared based on high-pressure closed loop testing.

80-1240

Free Vibrations of Rotors with Allowance for Linearized Characteristics of Bearings

M. Roszkowski
Institute of Appl. Mechanics, Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1630-1632, ASME (1979) 2 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Rotors (machine elements), Variable cross section, Stiffness coefficients, Damping coefficients, Natural frequencies

The paper presents the method of determining natural frequencies of long rotors with variable cross section, supported in two journal bearings. The rotor is characterized by parameters connected with the analysis of vibration of the rotor on rigid supports. The features of bearings are determined by a matrix of stiffness and damping coefficients. The frequency equation is derived and the method of finding its roots is explained.

80-1241

Extension of the Transfer Matrix Method for Rotordynamic Analysis to Include a Direct Representation of Conical Sections and Trunnions

M.S. Darlow, B.T. Murphy, J.A. Elder and G.N. Sandor
Mechanical Technology, Inc., Latham, NY 12110, J. Mech. Des., Trans. ASME, 102 (1), pp 122-129 (Jan 1980) 4 figs, 6 refs

Key Words: Rotors (machine elements), Variable cross section, Conical shells, Plates, Transfer matrix method, Mathematical models

A number of computer programs use the transfer matrix method to perform undamped critical speed, unbalance response, damped critical speed and stability analysis of rotors. This paper describes the analytical basis and the method of application for direct representation of conical sections and trunnions. Analytical results are currently being generated to demonstrate the need for and advantages of these modeling procedures.

80-1242

Sensitivity of the Critical Speeds of a Rotor to Changes in the Design

J.W. Lund
Dept. of Machine Elements, The Technical Univ. of Denmark, Lyngby, Denmark, J. Mech. Des., Trans. ASME, 102 (1), pp 115-121 (Jan 1980) 6 figs, 6 refs

Key Words: Rotors (machine elements), Critical speeds, Design techniques

This paper presents a scheme for computing the percentage change in critical speed as caused by a percentage change in any element of the rotor model. In this way it becomes possible to determine which elements are the most critical, and by how much they should be changed to effect the desired shift in critical speed. Such data also make it possible to adjust a given rotor model to bring it into agreement with measurements. The method can readily be incorporated into the conventional critical speed calculation and the additional computing time is insignificant.

80-1243

Study on Nonstationary Vibrations of Rotor Systems with Semirigid Spindles

I. Koretysski

Moscow Textile Institute, Moscow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 203-206, ASME (1979) 6 figs, 7 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Rotors (machine elements), Dynamic structural analysis

The report contains the results of investigation of nonstationary vibrations in systems with half-rigid textile spindle with resilient-and-pliant nonmassive supports having anisotropic characteristics, as well as for spring mounted electric spindle. The differential equations are solved by the traditional asymptotic method and by means of digital computers.

80-1244

Critical Speeds of Multi-Bearing Rotors

M. Hincz

Technische Universitat Lodz, Institut f. Angewandte Mechanik Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 219-222, ASME (1979) 7 figs, 3 refs

(For primary document, see 80-1477)

Key Words: Rotors (machine elements), Bearings, Stiffness coefficients, Critical speeds, Normal mode

Critical speeds of the whole rotor are determined from the critical speed of one rotor span. The influence of bearing stiffness on critical speeds and vibration modes of rotors is explained.

80-1245

Research on Helicopter Rotor Noise

H. Liebowitz and F. Farassat

School of Engrg. and Appl. Science, George Washington Univ., Washington, D.C., Rept. No. ARO-13517.3-EX, 13 pp (Oct 1979)

AD-A075 259/2

Key Words: Rotors (machine elements), Helicopter rotors, Noise generation, Noise reduction

This report summarizes the results of studies in the following areas: applications of generalized functions to aeroacoustics and aerodynamic problems; bounds on thickness and loading noise of rotating blades and the effects of blade sweep on reduction of the noise of rotating blades; study of nonlinear effects relevant to the rotor noise problem; and computational aspects of high speed rotor noise.

80-1246

Stability of an Unsymmetric Rotor on an Unsymmetric Support

I. Zvolanek

McDonnell Douglas Aircraft Co., St. Louis, MO, J. Amer. Helicopter Soc., 24 (5), pp 36-42 (Oct 1979) 10 figs, 1 table, 14 refs

Key Words: Rotors (machine elements), Helicopter rotors, Stability

The equations of motion are derived for a two-bladed rotor on an unsymmetric elastic support. Four degrees-of-freedom are considered. Two of these represent support flexibility, and two represent rotor flexibility. Stability is determined by various methods, and the results obtained are compared with previous work. These comparisons verify some qualitative predictions of earlier research and also identify new mechanisms of instability that have not been previously understood.

80-1247

On the "Twice Per Revolution" Vibration in Axially Unsymmetrical Shafts

N. Bachschmid, C. Diana, B. Pizzigoni and D. Borgese

Dept. of Mech. Engrg., Politecnico of Milan, Milan, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 195-198, ASME (1979) 5 figs, 5 refs

(For primary document, see 80-1477)

Key Words: Shafts (machine elements), Variable material properties, Unbalanced mass response

An approximate method for studying forced vibrations of rotors with unequal stiffnesses, due to its own weight, is proposed. The method leads to linear equations with constant coefficients in a fixed coordinate system: it is so possible to use all methods previously developed for rotating unbalance response.

80-1248

Dynamic Analysis of Two-Mass Drive System

W. Nadolski and A. Pielorz

Inst. of Fundamental Technological Research, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 306-309, ASME (1979) 5 figs, 2 refs

(For primary document, see 80-1477)

Key Words: Shafts (machine elements), Mathematical models

A model of a drive system consisting of two rigid bodies connected with a deformable shaft of the constant cross-section is investigated. The rigid bodies are loaded by non-periodical forces which may be described by means of Heaviside functions. Solutions are obtained in the form of recurrent formulae. Diagrams of displacements and deformations in some cross-sections of the shaft are given for some values of parameters of the model.

80-1249

A Rotor Supported Without Contact - Theory and Application

H. Ulbrich, G. Schweitzer and E. Bauser

Institute for Mechanics, Technical Univ. Munich, German Fed. Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 181-184, ASME (1979) 6 figs, 7 refs

(For primary document, see 80-1477)

Key Words: Rotor-bearing systems, Bearings, Magnetic bearings, Active isolation, Isolators

A rotor is supported contactless and without any wear by using electromagnetic bearings. In addition, the dynamical behavior of the rotor is optimized by controlling the bearing forces according to a specified control law.

80-1250

Effect of Non-Newtonian Lubricant on the Unbalance Response and Stability of a Flexible Rotor-Bearing System

C. Bajalingham, B.S. Prabhu, and B.V.A. Rao

Machine Dynamics Lab., Dept. of Appl. Mechanics, I.I.T. Madras, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 215-218, ASME (1979) 3 figs, 2 tables, 4 refs

(For primary document, see 80-1477)

Key Words: Rotor-bearing systems, Unbalanced mass response, Lubrication, Stiffness coefficients, Damping coefficients

In this paper the effect of non-Newtonian behavior of lubricant on the dynamic performance of a flexible rotor-bearing system is theoretically investigated. The lubricant is assumed to be an inelastic-viscous fluid of the Reiner-Philippoff type. The analysis which is applicable for both shear thinning and shear thickening fluids shows a significant influence of the non-Newtonian behavior of lubricant on the rotor response and stability.

80-1251

An Experimental Determination of the Instability of a Flexible Rotor in Four-Lobe Bearings

M.E. Leader, R.D. Flack, and D.W. Lewis

Monsanto, Texas City, TX, Wear, 58 (1), pp 35-47 (Jan 1980) 14 figs, 1 table, 12 refs

Key Words: Bearings, Rotor-bearing systems, Flexible rotors, Experimental data, Stability

A pair of preloaded four-lobe bearings were experimentally tested with a simple flexible rotor and the unbalance response and instability threshold were determined. Ten orientations of the bearings were used. Measurements included total response, synchronous response and frequency spectra at various running speeds. The rotor-bearing system exhibited the highest and lowest instability threshold for approximately load-off-pad and load-on-pad operating conditions respectively. The results showed moderate agreement with theoretical predictions.

80-1252

Dynamic Analysis of Mechanic Non-Holonomic Systems Used in Industrial Processes

Z.M. Zlokolica

Univ. of Novi Sad, Veljka Vlahovica, Yugoslavia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1593-1598, ASME (1979) 4 figs, 5 refs

(For primary document, see 80-1477)

Key Words: Rotating structures, Cable stranding machines, Holonomic systems, Dynamic structural analysis

A method for dynamic analysis of mechanical systems with nonholonomic connections is presented. Such systems are found in carpet, paper, cabel and similar industries, employing machines for rolling bands, where the synchronization of the angular speed of the element with the linear speed of rolled band has to be controlled automatically.

80-1253

The Vibrations of Multi-Rotor Machines on the Non-Linear Shock Absorbers

Z. Parszewski and Z. Miklaszewicz

Politechnika Lodzka, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 321-324, ASME (1979) 7 figs, 8 refs

(For primary document, see 80-1477)

Key Words: Shock absorbers, Rotating structures

In the paper differential equations of a one degree of freedom system with non-linear stiffness and damping are solved by means of an analog computer. Harmonic balance method is used for the identification of non-linear shock absorber parameters. Equations of motion of a multi-rotor machine supported on non-linear dampers are solved by means of *Runge-Kutta method. A comparison between theoretical* and experimental results, as well as application possibilities, are also presented.

80-1254

Optimization of Discrete Linear System Parameters from the Point of View of Dynamics

V. Zeman

College of Mechanical and Electrical Engrg., Plzen, Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 867-870, ASME (1979) 2 figs, 3 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Optimization, Vibration control, Periodic response, Rotating structures

A method for the optimization of structural parameters by minimizing the dynamic effects of stable, periodically excited vibrations is presented. The constrained nonlinear programming uses Powell's algorithm and are spectral properties of mass and stiffness matrices. The method is applied for the calculation of elastically supported torsional systems with geared transmission.

80-1255

Effects of Blade Shape and Casing Geometry on Noise Generation from an Experimental Centrifugal Fan

G. Krishnappa

Div. of Mech. Engrg., National Res. Council of Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1576-1579, ASME (1979) 9 figs, 1 ref

(For primary document, see 80-1477)

Key Words: Fans, Noise generation, Geometric effects

This paper describes the results of some experimental studies carried out to examine the effects of blade shapes and casing geometry on noise generation of an experimental fan. The noise generation and aerodynamic performance of the blade shape designed to produce constant deceleration along the blade passages were compared with that of the widely used circular arc blades. The operation of these two impellers was examined inside two casing configurations: a conventional volute casing with a short distance between the impeller tip and cut-off edge, and a circular casing with a wider gap.

80-1256

Acoustic Characteristics of Two Hybrid Inlets at Forward Speed

M.D. Falarski and M.T. Moore

NASA Ames Res. Ctr., Moffett Field, CA, J. Aircraft, 17 (2), pp 106-111 (Feb 1980) 13 figs, 2 tables, 8 refs

Key Words: Turbofan engines, Acoustic properties, Aerodynamic characteristics, Wind tunnel tests

A wind tunnel investigation of the acoustic and aerodynamic characteristics of two hybrid inlets installed on a JT15D-1 turbofan engine was performed. The hybrid inlets combined moderate throat Mach number and wall acoustic treatment to suppress the fan inlet noise. Acoustic and aerodynamic data were recorded over a range of flight and engine operating conditions. In a simulated flight environment, the

hybrid inlets provided significant levels of suppression at both design and off-design throat Mach numbers with good aerodynamic performance. A comparison of inlet noise at quasi-static and forward-speed conditions in the wind tunnel showed a reduction in the fan tones, demonstrating the flight cleanup effect.

80-1257
Acoustics and Performance of High-Speed, Unequally Spaced Fan Rotors

S. Fujii
National Aerospace Lab., Chofu, Tokyo, Japan, J. Engr. Power, Trans. ASME, 102 (1), pp 19-27 (Jan 1980) 17 figs, 12 refs

Key Words: Fans, Rotors (machine elements), Sound generation, Noise reduction, Experimental data

This paper describes an experimental measurement of the effects of uneven blade spacing on the acoustic and aerothermodynamic characteristics of high-speed, high-pressure-ratio fan rotors at two selected spacing configurations. A test rig, consisting of inlet guide vanes and transonic rotor blades, was employed to explore the redistribution of harmonic sound energy into a series of multiple tones of lower sound pressure level. The measured data indicated that a ten percent modulated rotor exhibited a six to eight decibel decrease in the sound pressure level as compared with the original first blade passage frequency harmonic.

80-1258
Coupled Bending-Torsion Flutter in Cascades

O. Bendiksen and P. Friedmann
Univ. of California, Los Angeles, CA, AIAA J., 18 (2), pp 194-201 (Feb 1980) 13 figs, 28 refs

Key Words: Turbomachinery, Flutter, Flexural vibration, Torsional vibration, Computer programs

A method is presented for determining the aeroelastic stability boundaries of a cascade with aerodynamic, inertial, and structural coupling between the bending and torsional degrees of freedom. A computer program has been written to systematically investigate the effect of this coupling on cascade stability over a wide range of design parameters. Results presented illustrate that the bending-torsion interaction has a pronounced effect on the cascade flutter boundary, despite no appreciable tendency toward frequency coalescence as flutter is approached. The analysis also indicates that bending flutter is possible even in the absence of finite mean lift.

80-1259
Some Problems of Reversible Machines Dynamics

V. Jaric, B. Milasincic, and D. Pustiac
Sour "Rade Koncar" Fallerovo Setaliste 22, Zagreb, Yugoslavia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1244-1249, ASME (1979) 4 figs, 6 refs
(For primary document, see 80-1477)
(In German)

Key Words: Turbomachinery, Pumps

In order to conserve energy, reversible machines are constructed which can be used either as turbines, or as pumps. In the article the effect of operational characteristics on motion dynamics is discussed; particularly, the dynamics of the vertical machine loaded by a large compressive force during transition. While acting as a turbine, this machine is loaded in tension by a force of about the same intensity.

80-1260
Noise and Vibrations of the Rotor System of a Compressor

W.J. Stojanowski
Inst. of Mechanics and Vibroacoustics, Academy of Mining and Metallurgy, Cracow, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 926-929, ASME (1979) 3 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Compressors, Compression noise, Noise reduction, Vibration control

An analysis of vibration sources and of the noise of a compressor are presented. An estimation of the influence of the constructional and technological parameters of the rotor system on the vibroacoustic activity of these sources was made and the vibroacoustic model described. On the basis of it, methods and directions of reduction of the vibroacoustic activity of the vibration and sound sources of the rotor compressor are analyzed. Application of these methods and the vibroacoustic synthesis of the machine as a whole are described.

80-1261
Learning from Case Histories

W.A. Utley and A.C. Salvidge

Dept. of the Environment, Noise Control Vib. Isolation, 10 (9), pp 377-379 (Nov/Dec 1979) 3 figs, 1

Key Words: Compressor noise, Noise reduction

A case history, involving the reduction of compressor noise is described in detail and is used to illustrate some of the main conclusions of the Building Research Establishment Current Paper. It also indicates the type of information which must be obtained in order to make a case history useful.

80-1262

Surge-Induced Structural Loads in Gas Turbines

R.S. Mazzawy

Pratt & Whitney Aircraft Group, East Hartford, CT, J. Engr. Power, Trans. ASME, 102 (1), pp 162-168 (Jan 1980) 15 figs, 8 refs

Key Words: Compressors, Gas turbine engines, Surges, Mathematical models

This paper is aimed toward explaining the fluid mechanics of the surge phenomenon and its impact on engine structures. It offers relatively simple models for estimating surge-induced loads on various engine components. The basis for these models is an empirical correlation of surge-induced inlet overpressure based on engine pressure ratio and bypass ratio. An approximate estimate of the post-surge axial pressure distribution can be derived from this correlation by assuming that surge initiation occurs in the rear of the compression system.

RECIPROCATING MACHINES

(Also see No. 1370)

80-1263

Synthesis of Hydraulic Mechanisms with Reciprocating Motion Having Extreme Characteristics

A.A. Grunawer and N.D. Gritsenko

Kharkov-2, UI, Frunze, Polytechnique Institute, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 781-784, ASME (1979) 2 figs, 5 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Hydraulic servomechanisms, Reciprocating engines, Optimization

On the basis of the optimal control theory, controlling actions have been obtained which provide minimum expenditure of energy at a given speed. Dynamic properties of mechanisms in which it is possible to control the moving force during the piston stroke have been considered. The procedure of engineering design of parameters of the mechanisms with extreme characteristics has been developed. This procedure is based on the method of harmonic linearization.

80-1264

Noise and Vibration Control of Motor Vehicle Units and Mechanisms

A.G. Zubakin and V.E. Koshkin

Central Automobile & Engine Res. Inst. (NAMI), Moscow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 918-921, ASME (1979) 6 figs, 4 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Motor vehicles, Motor vehicle noise, Noise reduction, Vibration control, Engine noise, Gear boxes, Noise measurement, Measuring instruments

A noise and vibration control system for vehicle engines and gear boxes is presented. Test benches and measuring instruments for the determination of noise and vibration of motor vehicle units is described. Vibration limit values for control objects are determined using statistical methods.

80-1265

Experiments on the Transmission Paths and Dynamic Behavior of Engine Structure Vibrations. I. Background and Static Tests

H. Okamura

Dept. of Mech. Engrg., Sophia Univ., Tokyo, Japan, J. Acoust. Soc. Amer., 67 (2), pp 538-545 (Feb 1980) 12 figs, 2 refs

Key Words: Engine vibration, Diesel engines, Experimental data

In order to establish a method of estimating the engine structure surface responses, a series of experiments was made on a four-cylinder, in-line, water-cooled high-speed diesel engine. The results obtained in static conditions are summarized with the necessary background. The propagation behavior of excitation forces in the engine structure,

the vibration behavior of the vibration transmission paths, and the transfer functions of the transmission paths were examined in static conditions. The distribution of the damping in the engine structure, the influence of cooling water, the lubrication oil, the oil pressure, and the crank position on the transfer functions were also examined.

80-1266
Experiments on the Transmission Paths and Dynamic Behavior of Engine Structure Vibration. II. Motoring Tests

H. Okamura
Dept. of Mech. Engrg., Sophia Univ., Tokyo, Japan,
J. Acoust. Soc. Amer., 67 (2), pp 546-550 (Feb 1980) 2 figs, 1 table

Key Words: Engine vibration, Diesel engines, Experimental data

In order to gain a better understanding of the transmission behavior of the excitation forces in the engine structure, such as the gas forces, the inertia forces, the piston slap forces, and the valve seating impact forces, a series of motoring tests was carried out on a four-cylinder, in-line, water-cooled high-speed diesel engine. The motoring tests were carried out by changing the combinations of the excitation forces, and at different engine speeds.

POWER TRANSMISSION SYSTEMS
(Also see Nos 1346, 1356, 1405)

80-1267
Load Support System Analysis-High Speed Input Pinion Configuration

S.S. Gassel and J. Pirvics
SKF Industries, Inc., King of Prussia, PA,
J. Lubric. Tech., Trans. ASME, 102 (1), pp 97-106 (Jan 1980) 20 figs, 2 tables, 15 refs

Key Words: Power transmission systems, Helicopters, Design techniques, Computer programs

A theoretical study has been made to determine the performance of a load support system, consisting of a shaft and two taper roller bearings for the high-speed input pinion of an advanced helicopter transmission. SHABERTH, a computer program designed to perform thermo-mechanical analyses of arbitrarily configured rolling element bearing-shaft systems, was employed to analyze, both, a straddle arrangement where the spiral bevel pinion gear is located axially between the two bearings, and a cantilevered arrangement where the pinion is outboard of the bearings. The results provide guidance for improved design of transmissions and the load vector control within them. In particular, the relative merits of the straddle versus the cantilever design have been exposed so that their individual characteristics may be exploited to increase system survivability.

80-1268
Experimental Dynamics of Cardan Shaft Locomotives Transmissions

N.I. Manolescu and T. Ionescu
Polytechnic Inst. Bucharest, Faculty of Transports, Chair of Mechanisms, Bucharest, Romania,
Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 767-770, ASME (1979) 5 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Power transmission systems, Shafts (machine elements), Interaction: rail-wheel, Railroad cars

The dynamics of primary cardan shaft transmission of the 1250 HP locomotive in the limit case of minimum radius curve negotiation is studied theoretically and experimentally. The results are processed by means of the digital computer.

80-1269
Dynamic Analysis of a Constant-Velocity Mechanism

J.H. Escobar and M.J. Gilmartin
Dept. of Mech. Engrg., Quito Polytechnic, Quito, Ecuador,
Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 457-461, ASME (1979) 4 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Power transmission systems, Mechanisms, Dynamic structural analysis

A dynamic analysis of the spatial five-link RCRCR mechanism adapted to transmit motion with a constant velocity ratio between two shafts is presented.

80-1270

Dynamics of Inertial Stepless Automatic Transformer of Driving Moment with Elastic Elements

A.I. Leonov and A.F. Dubrovsky
Cheliabinski, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 800-803, ASME (1979) 2 figs, 1 ref
(For primary document, see 80-1477)
(In Russian)

Key Words: Power transmission systems

A progressive inertial drive of machines and mechanisms possessing a number of advantages such as: automatical features which don't require the usage of the additional control devices, the stepless work, the high coefficient of efficiency, the compactness of construction, the wide range of momentum and speed control, and the vibration drive of momentum to the working member, is considered. The dynamics of the drive is analyzed on the basis of a generalized mathematical model giving the analytical description of various constructional schemes of the inertial drives. The nonlinear transformer vibrations on the dynamic coupling duty are studied and the generalized model influence on the unevenness of the engine rotation is examined. The optimal ranges of parameters and the corresponding optimal schemes of mechanisms are distinguished.

80-1271

Dynamic Design Study of a Hydrostatic Transmission System for Urban Buses

J. Svoboda
Mech. Engrg. Dept., Concordia Univ., Montreal, Quebec, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 684-687, ASME (1979) 7 figs, 6 refs
(For primary document, see 80-1477)

Key Words: Power transmission systems, Hydrostatic drives, Buses, Design techniques, Computer-aided techniques

This paper is concerned with the design of a novel hydrostatic transmission system for London transport buses aided by an analog computer model.

80-1272

A Theoretical Investigation of the Vibration of Roller Chain Drives

J.N. Fawcett and S.W. Nicol
Dept. of Mech. Engrg., Univ. of Newcastle Upon Tyne, UK, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1482-1485, ASME (1979) 6 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Mechanical drives, Chain drives, Mathematical models, Longitudinal vibration

A mathematical model of a roller chain drive is described from which the effects of longitudinal vibrations in the chain span can be predicted.

80-1273

On the Noise of Roller Chain Drives

K. Uehara and T. Nakajima
Dept. of Mech. Engrg., Toyo Univ., Kawagoe-shi, Saitama, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 906-909, ASME (1979) 13 figs, 2 refs
(For primary document, see 80-1477)

Key Words: Mechanical drives, Chain drives, Noise generation

The noise of roller chain drives is investigated. Three kinds of noise are recognized in the systems. The first one is radiated from meshing point and the cause of the noise is impact of roller chain against sprocket wheel and is called "meshing noise." The second one is the noise due to the angular fluctuation of transmission which is intrinsic in the chain and sprocket wheel system. The third one is the noise due to the knocking of the chain against chain guide. The nature and the generating mechanism of above three noises were examined theoretically and experimentally.

METAL WORKING AND FORMING

(Also see Nos. 1314, 1411)

80-1274

Dynamics Control and Application of the Differential Piston for the Feed Control of the Polishing Plates During Blades Production

Z. Parszewski and T. Adamiak
Inst. of Applied Mechanics, Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc.

of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1552-1555, ASME (1979) 4 figs, 8 refs
(For primary document, see 80-1477)
(In German)

Key Words: Machine tools, Metal working, Dynamic structural analysis

Dynamic properties of the differential piston joined with a head of the polishing machine are analyzed. The author describes the most important phases of the piston operation, especially: phase of feed and phase of work. The following problems are presented in mathematical form and solved: the work equation of the differential piston, the work equation of the piston damper (without an air supply), the travel equation of the piston (together with the polishing head), and the conditions of stability.

80-1275

Dynamic Acceptance Test for Machine Tools Using a Stochastic Model

M. Samaha, T.S. Sankar, and M.O.M. Osman
Mech. Engrg. Dept., Concordia Univ., Montreal, Quebec, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 45-52, ASME (1979) 3 figs, 2 tables, 14 refs
(For primary document, see 80-1477)

Key Words: Machine tools, Cutting, Dynamic stiffness, Mathematical models

In this investigation a nonlinear 2 degree-of-freedom mathematical model of a general machine tool is treated. The model is capable of describing the translation and rotation modes under the excitation of the cutting forces in the form of a Gaussian wide band stationary process. The equations of motion are established employing Fokker Planck technique that describes the stationary probabilistic response of the machine tool. The solution provides the mean square values of the translation and rotation modes from which the dynamic coefficient K_d is compared with those computed for an existing machine and an acceptance decision is formulated.

80-1276

On the Spatial Vibration of Milling Machines

B.C. George
Univ. of Galatz, Galatz, Romania, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1494-1497, ASME (1979) 12 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Machinery, Milling (machining), Mathematical models

A mathematical model for the study of the spatial vibration of the horizontal milling machine is proposed. Under the action of the three cutter force components, the machine behaves like an elastic system with 7 degrees of freedom, whose vibration may be analyzed by means of Lagrange's quadratic equations. The work opens up with "the dynamic concentrations of the distributed mass" in spheres of finite dimensions. Starting from the system of fixed axes, the systems of moving axes, solidly bound to various parts of the machine are obtained. The reference axes unit vectors are determined by using "the quaternionic rotation operator" and the coordinates of various points are determined by using "the positional, affin orthogonal tensor." Finally, the kinetic energy of the system is being determined.

80-1277

The Mechanism of Processing with Unbalanced Grinding Wheel

G. Varga and F. Sztanyik
Telecommunication Machine Factory of the Csepel Works "HITEKA," Budapest, Hungary, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 939-942, ASME (1979) 11 figs, 1 ref
(For primary document, see 80-1477)

Key Words: Machining, Cutting, Balancing techniques

The shape of the workpiece produced by a metal cutting machine depends on the relative position of the cutting tool and the workpiece. The unbalanced grinding wheel gives rise to vibration in the machine-workpiece-tool system. The shape of the machined workpiece can be calculated by the vibration conditions. The derivation of the analytical relation as well as the mechanism built for studying the processing of profiles are dealt with. It is also studied what extent should the grinding wheel be balanced and authors are seeking for other possibilities to avoid waviness caused by unbalanced grinding wheel.

80-1278

Stability of Self-Induced Vibrations in Metal Cutting

A. Lasota and P. Rusek

Jagellonian University, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1502-1505, ASME (1979) 5 figs, 19 refs
(For primary document, see 80-1477)

Key Words: Metal working, Cutting, Self-excited vibrations, Machine tools

A theory based on properties of delay differential equations which explains the existence of self-induced vibrations in metal cutting is presented. This theory allows to predict the conditions under which the vibrations occur and to determine their amplitude. In particular the theory explains the well known experimental facts that the amplitude of vibrations is a decreasing function of cutting speed and an increasing function of the tool wear.

80-1279
Improved Surface Finish and Reduced Vibration Level Through CMI -- Controlled Mechanical Impedance
SDRC Newsletter, 11 (1), p 10 (Feb 1980) 3 figs

Key Words: Machine tools, Vibration control, Chatter, Mechanical impedance

A controlled mechanical impedance machine tool system, which employs a feedback loop to control the mechanical impedance at the tool-workpiece interface is described. Any error between the actual and desired cut, as determined by comparing the electrical signals from a displacement transducer and reference signal, is corrected by a hydraulically positioned cutting tool. The system can be applied to new or existing machine tool designs. Ideal applications appear to be installations in which machine tool rigidity is insufficient to reduce chatter.

STRUCTURAL SYSTEMS

FOUNDATIONS

80-1280
Dynamic Response of a Simple Pile Structure to Wave Loading
N. Haritos and L.K. Stevens
Univ. of Melbourne, Australia, Instn. Engr., Australia, E.E. Trans., CE21 (2), pp 104-110 (Sept 1979) 5 figs, 1 table, 8 refs

Key Words: Pile structures, Dynamic response, Hydrodynamic excitation

A simple pile structure located in St. Vincent's Gulf, South Australia was instrumented in January 1978 as part of an experimental program aimed at studying the dynamic response of structures to hydrodynamic forces. Records obtained were analyzed to yield the observed acceleration response spectra for the structure in the direction of dominant wave energy. A theoretical model, using a spectral approach, was used to predict this response spectrum and was found to show very good agreement with the observed spectrum at the fundamental mode for the structure.

CONSTRUCTION EQUIPMENT

80-1281
Dynamic Behavior of a Stone Roughing Machine
M.A. Satter
Dept. of Mech. Engrg., Pahlavi Univ., Shiraz, Iran, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 234-237, ASME (1979) 5 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Construction equipment, Dynamic structural analysis, Damping effects, Impact response (mechanical)

Dynamically the machine was considered to be a single degree system which operates at or above resonance. A nonlinear damping term due to a variable orifice type damper (oil cushion) attached to the machine was considered. The forcing function is the impactive reaction between the stone and the roughing tool. The system response is computed numerically using the method of continuous analytic continuation. The effects of damping and impact parameters on the machine response have been obtained and discussed.

80-1282
Theoretical Behavior of a Vibratory Moldboard Plow
M. Aguirre-Gandara, A. Ramirez-Tapia and J.L. Hernandez-Cano
Instituto de Ingenieria, UNAM, DES, Facultad de Ingenieria, UNAM, Mexico, D.F., Mexico, Theory of

Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 955-959, ASME (1979) 6 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Agricultural machinery, Vibrating structures, Digital simulation

A simple arrangement is described for producing vibration of a moldboard plow, consisting basically of a spring-mass system in which there are no connecting bars or sliding parts and the exciting force is provided by an out-of-balance rotating weight. A tentative design of the vibratory system is given and its theoretical behavior determined by means of simulation in a digital computer.

80-1283
Calculation of Vibrating Conveyor

A Czubak
College of Science and Technology, Port Harcourt, Nigeria, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 74-77, ASME (1979) 8 refs
(For primary document, see 80-1477)

Key Words: Vibrators (machinery), Conveyors, Vibrating structures

A method for the calculation of vibrating parameters, required for the design of a vibrating conveyor, is presented. It considers the motion phenomena of transported material, the power due to losses of energy in the load and the exciting force on the assumption that the layer of material acts as a dynamical damper. The method can be also applied to any other vibrating machine transporting bulk material.

80-1284
Design Analysis of Feedbowls

D.E. Ferguson, A.G. Erdman, and D.A. Frohrib
Mech. Engrg. Dept., Univ. of Minnesota, Minneapolis, MN, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 61-64, ASME (1979) 6 figs, 3 tables, 5 refs
(For primary document, see 80-1477)

Key Words: Vibrators (machinery), Conveyors, Mathematical models, Computer programs

The feedbowl is a device widely used by industry for feeding the component parts of a product into an assembly station. A motor drives the feedbowl spring-mass system at very near one of its natural frequencies. A computer program was developed to mathematically model the feedbowl in an attempt to provide a means of optimizing desired characteristics of any specific bowl. Analytical results are compared with experimental findings.

80-1285
Investigations on the Dynamic Behaviour of Plate Vibrators

S.H. Mohsin
Aligarh Muslim Univ., Aligarh, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 102-106, ASME (1979) 13 figs, 11 refs
(For primary document, see 80-1477)

Key Words: Vibrators (machinery), Soil compacting, Compaction equipment, Mathematical models

A theoretical method was developed for the investigation of the dynamic behavior of plate vibrators. The mathematical model of the vibrator has two degrees of freedom. The soil was replaced by the Bathelt's plastic-elastic model. The entire period of motion can be divided into five different processes. The calculations were carried out for a plate vibrator for two different types of soils in order to check the exactness of the method. A comparison with the results obtained by measurement showed a very good agreement. It was found that the effect of the soil constants on the dynamic behavior is small.

80-1286
On the Dynamics of High Power Earth-Moving Machines

G. Kunad, R. Kluge, H. Buge, and A. Wetzel
Technische Universitat Dresden, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1232-1235, ASME (1979) 8 figs, 8 refs
(For primary document, see 80-1477)
(In German)

Key Words: Dredges, Mathematical models, Vibration control

Dredging process, as well as the kinematics of chain drive, cause large dynamic moments in the bucket chain of the

dredge, limiting its capacity and reliability. A mathematical model, based on the experimental investigation of bucket chain drives, describing the dynamic response of the drive is derived. The model provides various solutions for drives with reduced dynamic loading. The solutions are based on the principle of vibration elimination by tuning system parameters, or the insertion of vibration eliminators.

POWER PLANTS

80-1287
Elimination of Low Frequency Vibration in Marine Power Plants

A.F. Gal, A.P. Gurov, G.D. Zhukov, and G.P. Nerubenko
USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1490-1493, ASME (1979) 1 fig, 7 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Electric power plants, Shipboard equipment response, Vibration control

Marine power plants are mounted on elastic hull structures, which brings characteristic features into their operation conditions; these features are displayed in vibrational interaction between operating engine and elastic frame. The sources of vibration exist both in the engine itself and in the environment, surrounding it. Synthesis is made with regard to forces of excitation, acting upon the engine and elastic frame, forces amplitudes and their frequency values being varying quantities in general case.

80-1288
Nonlinear Dynamic Model of a Fluidized-Bed Steam Generation System

A. Ray, D.A. Berkowitz, and V.H. Sumaria
The MITRE Corporation, Bedford, MA, J. Engr. Power, Trans. ASME, 102 (1), pp 202-208 (Jan 1980) 9 figs, 2 tables, 15 refs

Key Words: Electric power plants, Boilers, Digital simulation, Mathematical models

A dynamic model of an atmospheric pressure fluidized-bed steam generation system is presented which allows digital simulation and analytical controller design. The nonlinear, time-invariant, deterministic, continuous-time model is derived in state-space form from conservation relations, empirical correlations and system design data. The model has been verified for steady-state and transient performance with measured data from experimental test runs. Transient responses of several process variables, following independent step disturbances in coal feed rate and air flow, are illustrated.

80-1289
Outdoor Noise of Coal-Fired Power Plants

E.E. Dennison, D.C. Kanistanaux, and S. Ying
Gilbert/Commonwealth, Commonwealth Associates, Inc., 209 E. Washington Ave., Jackson, MI 49201, Noise Control Engr., 14 (1), pp 30-37 (Jan/Feb 1980) 14 figs, 5 refs

Key Words: Fossil power plants, Noise generation

Equipment typical of fossil fuel power plants can produce both continuous and transient noise. In a thorough study, the outdoor noise of several coal-fired power plants was measured. The impact on the community as well as possible controls are suggested.

80-1290
A Seismic Analysis Method for a Block Column Gas-Cooled Reactor Core

T. Ikushima and T. Nakazawa
Japan Atomic Energy Res. Inst., Tokai-mura, Ibaraki-ken, Japan, Nucl. Engr Des., 55 (3), pp 331-342 (Dec 1979) 10 figs, 10 refs

Key Words: Nuclear reactors, Seismic response

An analytical method for predicting the behavior of a prismatic high-temperature gas-cooled reactor (HTGR) core under seismic excitation has been developed. Analytical results are compared with experimental results and are found to be in good agreement. The analytical method can be used to predict the behavior of the HTGR core under seismic excitation.

80-1291
Analytical and Experimental Studies of the Modeling of a Class of Nonlinear Systems

V.Z. Marmarelis, S.F. Masri, F.E. Udwadia, T.K. Caughey, and G.D. Jeong
School of Engrg., Univ. of Southern California, Los Angeles, CA 90007, Nucl. Engr. Des., 55 (1), pp 59-68 (Dec 1979) 11 figs, 4 refs

Key Words: Nuclear reactor components, Nonlinear systems, Nonparametric identification techniques, System identification techniques, Signatures

This paper deals with the identification of complex structural and mechanical systems often encountered in the nuclear industry. Nonparametric identification techniques are used to analyze the response of a class of nonlinear components. Efficient computational algorithms and experimental techniques based on nonparametric system identification methods such as the Wiener-kernel approach and least-squares regression techniques involving the system state-variables are developed and applied to an example system. The variation of system signature with its change in characteristics is studied and the effects of various parameters of the excitation, system, and the computation algorithm on the signature analysis are investigated.

VEHICLE SYSTEMS

GROUND VEHICLES

(Also see Nos 1268, 1271, 1324, 1325, 1326)

80-1292
Dynamics of a Three-Wheeled Vehicle

H. Hatwal and A. Ghosh
Dept. of Mech. Engrg., Indian Inst. of Tech., Kanpur, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 930-934, ASME (1979) 9 figs, 2 refs
(For primary document, see 80-1477)

Key Words: Ground vehicles, Mathematical models

Three wheeled vehicles belong to a class of systems which are non-holonomic in nature. A mathematical model for such a vehicle has been formulated to investigate the dynamics and the directional stability. Experiments have been performed and the experimental results are in fairly good agreement with the analytical predictions.

80-1293
Bus Noise Levels in the New York City and Albany Metropolitan Areas

L.F. Cohn
Dept. of Civil Engrg., Vanderbilt Univ., Nashville, TN 37235, Noise Control Engr., 14 (1), pp 38-42 (Jan/Feb 1980) 3 figs, 2 tables, 6 refs

Key Words: Traffic noise, Buses, Noise prediction

While buses ordinarily make up only a very small percentage of vehicles in a typical traffic stream, there are certain situations in which they can dominate noise levels. Two such situations are analyzed through a series of noise measurements. Results of these studies include a bus noise emission level and spectrum for a typical urban bus, and a regression analysis to determine the feasibility of an empirically based prediction model.

80-1294
Evaluation of the Braking Performance of a Tractor-Semitrailer Equipped with Two Different Types of Anti-Lock Systems

C.P. Lam, R.R. Guntur, and J.Y. Wong
Dept. of Mechanical and Aeronautical Engrg., Transport Tech. Res. Lab., Carleton Univ., Ottawa, Canada, SAE Paper No. 791046, 20 pp, 20 figs, 6 refs

Key Words: Articulated vehicles, Tractors, Semitrailers, Brakes (motion arresters), Mathematical models

In this paper, a digital computer model for studying the braking performance of an articulated vehicle equipped with anti-lock devices is presented. Using this computer model, the braking characteristics of a tractor-semitrailer fitted with a commercially available system (System A) is compared with that of the same vehicle equipped with a proposed system (system B). The deficiencies of system A are identified. The merits and disadvantages of system B are also examined. Based on the results of the simulation study, guiding principles for the development of the control logic of anti-lock brake systems are suggested.

80-1295
Longitudinal Dynamics of the Train Consisting of Cars of Continuous Draw Bar Modelled as a System of Elastic Discrete Masses

K. Horvath

Dept. of Railway Vehicles, Technical University Budapest, Budapest, Hungary, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 284-288, ASME (1979) 6 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Railroad trains, Longitudinal response, Mathematical models

The longitudinal dynamics problem of trains consisting of a locomotive of mass M_0 and of cars of masses M_i is described by a nonlinear differential equation system of second order to be solved numerically. Integration of the system of the equations of motion taking into consideration the structure matrix of the mechanical system yields the wanted quantities, i.e. the distance covered, velocity and acceleration of each vehicle and the connection forces.

80-1296

Analysis of Nonlinear Hunting Vibrations of Rail Vehicle Trucks

A. F. D'Souza and P. Caravavatna
Dept. of Mechanics and Mech. and Aerospace Engrg., Illinois Inst. of Tech., Chicago, IL 60616, J. Mech. Des., Trans. ASME, 102 (1), pp 77-85 (Jan 1980) 13 figs, 7 refs

Key Words: Trucks, Railroad cars, Freight cars, Hunting motion

Truck hunting of rail freight vehicles is investigated on a tangent (i.e., straight) track with the carbody moving at a certain constant forward velocity. The truck has three degrees of freedom in the lateral, yaw, and parallelogramming directions. The method of describing functions is employed for the investigation of hunting. The orbital stability of limit cycles is investigated by employing the energy balance. The effects of the various parameters on hunting are investigated by parametric studies.

80-1297

Dynamic Rocking Response and Optimization of the Nonlinear Suspension of a Railroad Freight Car

M. Samaha and T. S. Sankar
Dept. of Mech. Engrg., Concordia Univ., Montreal, Canada, J. Mech. Des., Trans. ASME, 102 (1), pp 86-93 (Jan 1980) 14 figs, 3 tables, 14 refs

Key Words: Railroad cars, Freight cars, Mathematical models, Suspension systems (vehicles)

A modified mathematical model of a large capacity railroad freight vehicle is presented. The model for this investigation is constructed in such a way to describe the bounce, sway and rocking modes of the system and also to account for most of the vehicle nonlinearity effects. The optimum parameters are presented in different forms either for the existing or for stabilized vehicle configuration.

80-1298

Random Processes and Transfer of Dynamic Systems

L. Rus
CKD Praha, zavod Lokomotivka, Res. Inst. of Locomotives, Praha, Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 408-411, ASME (1979) 4 figs, 6 refs
(For primary document, see 80-1477)

Key Words: Interaction: rail-wheel, Railroad trains, Stability

The paper deals with the theory of random processes necessary for solving the dynamic systems. A method is given for computing the transfer functions for oscillation of rail vehicles by consideration clearance between the wheel flange and the rail. Since the problem is non-linear, due to the geometrical relations in the wheel-rail contact, the method of statistical linearization was used.

80-1299

Dynamics of Non-Linear System: Railway Vehicle-Railway Track in Curve

N. Cucuz
Faculty of Transport & Traffic Engrg., Univ. of Belgrade, Belgrade, Yugoslavia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 293-296, ASME (1979) 5 figs, 3 refs
(For primary document, see 80-1477)

Key Words: Interaction: rail-vehicle, Mathematical models, Nonlinear systems

In this paper, the behavior of the system railway vehicle-railway track is studied from the running stability point of view. In order to make a description of the observed problem real, a great many of non-linear factors appear in the mathe-

matical model of the system which are connected with characteristics of the elements of the suspension system and with characteristics of the railway track, such as: forces of friction in suspension rings, spring forces characteristics in axle guards, relation between slip and tangential force, nonlinearities taking into account real profile forms of wheel type and railhead, etc.

80-1300
Crash Test Dummy Lower Leg Instrumentation for Axial Force and Bending Moment

G W. Nyquist and R.A. Denton
General Motors Corp., ISA Trans., 18 (3), pp 13-22 (1979) 9 figs, 3 tables, 2 refs

Key Words: Collision research (automotive), Anthropomorphic dummies, Measuring instruments

Instrumented anthropomorphic dummies of humans have been used in automobile occupant crash protection research and development programs for many years. Lower leg instrumentation provides the safety engineer with a valuable tool for gaining otherwise unavailable insights into occupant restraint system performance. Instrumentation described in this paper constitutes an advancement of the state of the art of dummy test technology. Transducer fabrication and calibration procedures are also discussed.

SHIPS
(Also see No. 1287)

80-1301
Ships Machine Aggregates Dynamic Analysis by Means of Electronic Digital Computer

V.I. Nebesnov
Institute of Marine Engrg., Odessa, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 654-658, ASME (1979) 4 figs, 2 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Ships, Dynamic structural analysis, Computer-aided techniques

Vibro-transport machines are used in the industry for some of the following processes associated with powdery and granular materials, i.e., drying, cooling, fire hardening, and separation. This paper examines some of the vibration problems associated with the design and operation of vibro-transport machines and mechanisms.

80-1302
Noise Control Design Problems on Air Cushion Vehicles and Surface Effect Ships

M.E. Dvornak
Bell Aerospace Textron, P.O. Box 29307, New Orleans, LA 70189, Noise Control Engr., 14 (1), pp 12-23 (Jan/Feb 1980) 13 figs, 2 tables, 13 refs

Key Words: Surface effect machines, Ships, Noise reduction

An overview of noise control design problems on surface effect vehicles is presented. There are several general operating characteristics and acoustic design features which make this type of craft different from conventional ships. As a result, attention must be given to all potential noise sources in order to achieve the objective of a quiet and habitable ship.

AIRCRAFT
(Also see Nos. 1245, 1323, 1476)

80-1303
Airframe Noise Component Interaction Studies

M.R. Fink and R.H. Schlinker
United Technologies Res. Ctr., East Hartford, CT, J. Aircraft, 17 (2), pp 99-105 (Feb 1980) 11 figs, 19 refs

Key Words: Aircraft, Acoustic properties, Wind tunnel tests

Acoustic wind-tunnel tests were conducted to examine the noise-generating processes of an airframe during approach flight. The airframe model was a two-dimensional wing section, to which high-lift leading and trailing edge devices and landing gear were added. Far-field conventional microphones were utilized to determine component spectrum levels. An acoustic mirror directional microphone was utilized to examine differences in noise source distributions on airframe components extended separately and in combination.

80-1304
Noise Transmission into a Light Aircraft

R. Vaicaitis

Columbia Univ., New York, NY, J. Aircraft, 17 (2), pp 81-86 (Feb 1980) 8 figs, 19 refs

Key Words: Aircraft, Interior noise

An analytical study on noise transmission into a cabin of a twin-engine G/A aircraft is presented. The solution of the governing acoustic-structural equations of motion is developed utilizing modal expansions and a Galerkin-type procedure. The exterior noise pressure inputs are taken from available experimental data. A direct comparison between theory and experiments on cabin noise levels is given. Interior noise reduction by stiffening, mass addition, and damping treatments is investigated. It is shown that a combination of added mass and damping could significantly reduce interior noise levels for this aircraft.

80-1305

A Velocity Potential Panel Method for the Prediction of Unsteady Airloads on Oscillating Wings and Bodies

W. Geissler

Inst. f. Aeroelastic d. Deutsche Forschung u. Versuchsanstalt f. Luft u. Raumfahrt E.V., Göttingen, West Germany, Arch. Mech., 31 (5), pp 595-603 (1979)

Key Words: Aircraft wings, Panels, Fluid-induced excitation

A method is presented to calculate unsteady airloads on oscillating three-dimensional wings and bodies in subsonic flow. This method is based on the velocity potential using distributions of harmonically pulsating doublets in the case of wings, and harmonically pulsating sources and sinks in the case of bodies. The method is applied to a variety of geometrical configurations and flow conditions. The results are compared with other methods as well as with experimental results.

80-1306

Evaluation of a Describing Function Approach to Nonlinear Gust Loads Analysis

R.L. Stapleford and R.J. DiMarco

Systems Technology, Inc., Hawthorne, CA, J. Aircraft, 17 (2), pp 87-94 (Feb 1980) 8 figs, 8 refs

Key Words: Aircraft, Wind induced excitation, Functional analysis, Monte Carlo method

Structural loads on the vertical tail of an aircraft with a limited authority yaw damper are calculated. The results of a random input describing function analysis are compared with those of a Monte Carlo simulation. Comparisons of exceedance rates and other statistics are presented.

80-1307

Vibrational Modes of an Aircraft Simulator Motion System

R. Hoffman and M.G. McKinnon

McGill Univ., Montreal, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 603-606, ASME (1979) 2 figs, 4 refs

(For primary document, see 80-1477)

Key Words: Aircraft, Simulation, Natural frequencies, Mode shapes, Computer programs

This paper describes how the vibrational characteristics of an aircraft simulator motion system are analyzed by means of the finite element computer program SAP IV. It is shown that SAP IV is an efficient tool to analyze the mechanical system but that the effects of feedback control of the servo space cylinders cannot readily be included.

80-1308

Investigation of the Crash-Impact Characteristics of Advanced Airframe Structures

J.D. Cronkhite, T.J. Haas, V.L. Berry, and R. Winter

Bell Helicopter Textron, Fort Worth, TX, Rept. No. USARTL-TR-79-11, 222 pp (Sept 1979)

AD-A075 163/6

Key Words: Crash research (aircraft), Crashworthiness, Composite materials, Energy absorption

The purpose of this program was to investigate the crash-impact characteristics of advanced troop transport helicopter airframe structures constructed of composite materials. Currently available information was surveyed on the crash-impact behavior of composite materials, analytical tools for design of crashworthy airframe structures, and airframe structure crashworthiness design criteria. Effects of composite materials on the compliance of airframe structures with current Army crashworthiness requirements are discussed.

80-1309
Use of Multiblade Coordinates for Helicopter Flap-Lag Stability with Dynamic Inflow
G.H. Gaonkar and D.A. Peters
India Inst. of Science, Bangalore, India, J. Aircraft, 17 (2), pp 112-118 (Feb 1980) 8 figs, 9 refs

Key Words: Helicopters, Rotors (machine elements), Blades, Stability

Rotor flap-lag stability in forward flight is studied with and without dynamic inflow feedback via a multiblade coordinate transformation. The advantages of multiblade coordinates are pronounced when the blades are coupled by dynamic inflow.

BIOLOGICAL SYSTEMS

HUMAN

(Also see Nos. 1300, 1429)

80-1310
Occupational Impact/Impulse Noise - An Overview
A.C. Poulos, D.E. Wasserman, and T.E. Doyle
National Inst. for Occupational Safety and Health, Cincinnati, OH, S/V, Sound Vib., 14 (1), pp 8-12 (Jan 1980) 2 figs, 5 tables, 10 refs

Key Words: Noise tolerance, Human response, Industrial facilities

The National Institute for Occupational Safety and Health has developed a five phase research plan concerning occupational impact/impulse noise exposure. This article deals primarily with the results from the completion of Phases I (assessment of the current state of knowledge) and II (industrial plant tours) of this overall research plan. The results are presented for the 25 industrial walk-through tours conducted. Impact/impulse noise exposure is discussed by industrial processes and industry type.

80-1311
Performance Characteristics and Working Comfortableness of Forest Workers of a New Non-Vibration Chain Saw Utilizing Perfectly Balanced Rotation-Reciprocation Device
K. Ishida and T. Matsuda
Faculty of Engrg., Fukui Inst. of Tech., Fukui, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 951-954, ASME (1979) 7 figs, 3 refs
(For primary document, see 80-1477)

Key Words: Saws, Vibration tolerance, Human response

Forest workers, making occupational use of the chain saw, have been affected with the vascular disease disorders of the fingers and hands. This paper presents the performances of the non-vibration chain saw.

80-1312
Modern Problems of the Vibration Research in Machines and Systems "Man-Machine"
K.V. Frolov
Inst. for the Study of Machines, Mowcow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1640-1654, ASME (1979) 9 figs, 5 tables, 19 refs
(For primary document, see 80-1477)

Key Words: Machinery vibration, Vibration control, Human response, Vibration excitation

The lecture deals with some new problems of machine vibrations related to objectives of ecology, ergonomics and automatization. Some examples are cited illustrating the effective use of computer for the solution of problems of nonlinear vibration theory and development of methods to reduce vibrations in machines and mechanisms.

80-1313
Problems of Vibrations in the Systems "Man-Machine-Environment"
K.V. Frolov
Inst. for the Study of Machines, Moscow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1226-1228, ASME (1979)
(For primary document, see 80-1477)
(In Russian)

Key Words: Human response, Machinery vibration, Vibration excitation

Problems of dynamics of the systems "man-machine-environment" are formulated in the paper. The main consideration is given to the biodynamic behavior of a man-operator in the conditions of vibrational influence. The areas of application of the problems formulated in the conditions of control of the new machines of vibrational principle of action have been obtained. A review of works accomplished in the Institute for the Study of Machines and devoted to the creation of dynamic models of the man-operator and the creation of controllable vibroprotective systems with regard for the virtues of the man-operator is given.

80-1314

Optimization of Design of Hand-Held Tools with Vibration-Shock-Action by Means of Mathematical Models

S. Kirchberg and G. Meltzer

Zentralinstitut f. Arbeitsschutz, Dresden, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 134-138, ASME (1979) 8 figs, 1 table, 5 refs

(For primary document, see 80-1477)

(In German)

Key Words: Optimization, Vibratory tools, Machine tools, Vibration excitation, Human response

A method for optimization of hand-held tools with vibration-impact-action is presented. The aim of optimization is the reduction of vibrations felt by operators hand at the handle without changing the level of vibrations acting on the instrument. For this purpose a mathematical model of the machine as well as the hand-arm system of operator and the workpiece was derived. The technique is illustrated by optimizing the design of an impact-drilling machine.

80-1315

Experimental Investigations of Multi-Impact Wrenches

J. Baumgarten, B. Bialkowicz, and A. Oledzki

Technical Univ. of Warsaw, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 466-469, ASME (1979) 4 figs, 1 table, 7 refs

(For primary document, see 80-1477)

Key Words: Machine tools, Impact response (mechanical), Human response

This paper describes experimental investigations on impact wrenches, with purpose to determine the danger they create for the operator's health. Results of those investigations showed that impact wrenches constitute, according to I.S.O. Standard, more danger for human health than commonly considered very dangerous chain saw.

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

(Also see Nos. 1249, 1253, 1297, 1308, 1326, 1337, 1377)

80-1316

Effect of Primary Damping on the Tuning Conditions of a Dynamic Vibration Absorber

V.A. Bapat and H.V. Kumaraswamy

Dept. of Mech. Engrg., Indian Inst. of Science, Bangalore, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 329-332, ASME (1979) 4 figs, 2 refs

(For primary document, see 80-1477)

Key Words: Vibration absorption (equipment), Vibration tuning, Dynamic vibration absorption (equipment)

The tuning conditions for a dynamic vibration absorber with small but non-zero primary damping are developed starting from the case of undamped primary system. Explicit relationships giving the dependence of tuning conditions and optimum absorber damping as functions of the absorber mass ratio and primary damping ratio are obtained.

80-1317

Some Experience with Dynamic Absorbers for Impeller Pumps

S.S. Stecco and A. Janigro

Univ. of Florence, Firenze, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 650-653, ASME (1979) 5 figs, 1 table, 2 refs

(For primary document, see 80-1477)

Key Words: Vibration absorption (equipment), Dynamic vibration absorption (equipment), Cantilever beams, Pumps, Vibration tuning

The paper shows a correct design approach for cantilevered dynamic absorbers, when relatively high frequencies are faced. An application case - referred to a pump in a refinery plant - is presented, showing the effectiveness of the procedure.

80-1318

A Dynamic Vibration Damper with an Active Frequency Tuning

H. Holka

Academy of Engrg. & Agriculture, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 333-336, ASME (1979) 4 figs, 4 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Vibration tuning, Vibration dampers, Active isolation

In the following paper the dynamic damper with two degrees of freedom is presented. This provides the possibility of continuous change of the exciting force frequency and adjustment of the system to variable conditions follows automatically.

80-1319

Dynamic Characteristics of Passive and Active Flexible Vibrating Objects

W. Wodzicki

Inst. of Appl. Mechanics, Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 289-292, ASME (1979) 4 figs, 5 refs

(For primary document, see 80-1477)

Key Words: Vibration isolators, Vibrating structures, Receptance method

The paper presents an analytical-experimental method of determining dynamic characteristics of any passive and active linear flexible vibrating object such as the casing of an instrument or an operator's cab or flexible body of a machine.

80-1320

Adelisor and Eladisor of New Spring Elements

J. Jerabek

Vysoka Skola Dopravna, Moyzesova, Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 445-448, ASME (1979) 5 figs

(For primary document, see 80-1477)

(In German)

Key Words: Vibration isolators, Coulomb friction

The author has developed new vibration elements with frictional damping which exhibit special properties. The paper presents results based on the theory, experiments, and experience in practical applications of new vibration insulators ADELISOR and ELADISOR. They can be economically utilized to suppress vibrations in machines and groundworks as well as for damping of vibrations generally.

80-1321

Stabilization of Self-Excited Oscillations

D.L. Taylor

Sibley School of Mech. and Aerospace Engrg., Cornell Univ., Ithaca, NY, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 404-407, ASME (1979) 5 figs, 6 refs

(For primary document, see 80-1477)

Key Words: Self excited vibrations, Vibration absorption (equipment)

Many different physical systems have been found to display self excited oscillations under certain operating conditions. Under certain circumstances, a self excited system can be stabilized by the addition of a classical, passive vibration absorber. The specific example of a one degree of freedom system with negative damping is used to demonstrate the procedure.

80-1322

Analysis of Airspring Isolators

J.R. Baumgarten and G.E. Andersen

Dept. of Mech. Engrg., Univ. of Nebraska, Lincoln, Nebraska, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 337-340, ASME (1979) 6 figs, 2 tables, 7 refs

(For primary document, see 80-1477)

Key Words: Vibration isolators, Machinery vibration, Pneumatic springs

Airspring isolators provide a convenient means of achieving a low natural frequency in mounting heavy machines. For the calculation of natural frequencies of these inflated structures load deflection characteristics are required. This study defines the pressure-volume relationship for deflecting toroidal shapes. The spring rate for this class of isolators is then determined assuming an adiabatic compression process. Experimental studies are presented for one specific isolator design. Good agreement with predicted natural frequency is obtained for inelastic wall construction.

80-1323

Summary of Noise Reduction Characteristics of Typical General Aviation Materials

J. Roskam, F. Grosveld and J. van Aken

Univ. of Kansas, Lawrence, KS, SAE Paper No. 790627, 40 pp, 52 figs, 1 table, 9 refs

Key Words: Noise reduction, Absorbers (materials), Vibration damping, Aircraft noise

The paper presents the results of a large number of systematic tests to determine noise reduction characteristics of general aviation materials. Effects of material type (metallic and composite), thickness, panel stiffening, vibration damping materials, sound absorption materials and pressurization on noise reduction are included. Several promising methods for reducing cabin interior noise in light airplanes are discussed based on the results.

80-1324

Evolution of the New Ford Light Truck Four Wheel Drive Independent Front Suspension

G.S. Bedi and W.H.R. Lake

Ford Motor Co., SAE Paper No. 791035, 49 pp, 30 figs

Key Words: Suspension systems (vehicles), Trucks, Design techniques

A new twin traction beam, independent front suspension system, for 1980 model Ford light duty 4x4 trucks, has been designed, developed and is in U.S. domestic production by Ford Motor Company. This paper describes the objectives, evolution of design, development, testing, and manufacturing and assembly chronology of the newest suspension system.

80-1325

Dynamics of Railroad Cars Fitted with Automatic Coupling Units

T. Tomaszczyk and A. Oledzki

Polish State Railway Res. Inst., Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 692-695, ASME (1979) 4 figs, 4 refs

(For primary document, see 80-1477)

Key Words: Shock absorbers, Railroad cars, Simulation, Mathematical models, Computer programs

The described rheological model of a railway shock absorber (draft gear) was used, along with locomotive, brake and load system models, to simulate longitudinal displacements in a train.

TIRES AND WHEELS

80-1326

On the Predictability of Dynamic Wheel Loads in Automobile Proving Ground Tests

H.K. Sachs and J.J. Johnson

Wayne State Univ., Detroit, MI, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 935-938, ASME (1979) 6 figs, 7 refs

(For primary document, see 80-1477)

Key Words: Wheels, Suspension systems (vehicles), Automobiles, Mathematical models

A model of an automobile front suspension is discussed for the purpose of predicting peak dynamic wheel loads as experienced in proving ground tests. The vehicle is reduced to an ideal rigid body having two degrees of freedom (yaw and lateral motions) when operated at uniformly accelerated or decelerated steady state motion on a rough surface. The unsprung wheel masses are constrained to move over sinusoidal terrain profiles of varying wave lengths and the wheel plane to precess about the king pin axis at reasonable rates consistent with driver steering input.

BLADES

(Also see No. 1355)

80-1327

On Discrete Modelisation of Response of Blades with Slip and Hysteretic Damping

A. Muszynska and D I.G. Jones
Inst. of Fundamental Technological Res., Polish Academy of Sciences, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 646-649, ASME (1979) 5 figs, 10 refs
(For primary document, see 80-1477)

Key Words: Blades, Slip amplitude, Hysteretic damping, Mathematical models

In studying blade-disc interactions as they affect dynamic response, allowing for interface slip and hysteretic damping, it is important to be able to simplify the physical models. In this paper, the authors discuss two- and three-mass models of a single blade in a disc or fixture, allowing for slip both at the root and at another point, and hysteresis in the blade. Experimental response data for a simple blade in a test fixture, under low level harmonic excitation is examined, and its significance reviewed in terms of the simple model analysis.

80-1328

Turbomachine Blade Vibration

J.S. Rao
Indian Institute of Tech., New Delhi, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 637-640, ASME (1979) 62 refs
(For primary document, see 80-1477)

Key Words: Blades, Turbomachinery blades, Fluid-induced excitation, Resonant response

Calculation procedures based on two dimensional compressible and incompressible flow are discussed, for thin cambered aerofoils in transverse and chordwise gusts. Numerical procedures to determine natural frequencies of turbomachine blades are also discussed, along with methods of determining forced vibration and resonant stresses. Emphasis is given to the work being carried out in India.

80-1329

A Combined Finite Element-Transfer Matrix Method for the Theoretical Evaluation of Free Vibrations of Pretwisted-Turbomachinery Blades

G. Chiatti and A. Sestieri
Instituto di Macchine, Univ. of Rome, Rome, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 629-632, ASME (1979) 1 fig, 12 refs
(For primary document, see 80-1477)

Key Words: Blades, Turbomachinery blades, Natural frequencies, Finite element technique, Transfer matrix methods

The prediction of coupled natural frequencies of turbomachinery blading is very important for preventing possible damages of the blades with consequent failure or shutdown of the whole machine. In this paper a proposal for the evaluation of these frequencies, which jointly use the finite element and the transfer matrix methods is presented.

80-1330

Comparison of Predicted and Experimental Rotor Loads to Evaluate Flap-Lag Coupling with Blade Pitch

R.E. Hansford
Westland Helicopters, Yeovil, Somerset, UK, J. Amer. Helicopter Soc., 24 (5), pp 3-11 (Oct 1979) 9 figs, 1 table, 16 refs

Key Words: Rotors (machine elements), Rotor blades, Blades, Fatigue life, Mathematical models

An analytical model for the prediction of rotor performance and structural loads has been developed to include time-dependent variations in blade stiffness using a modal approach. Comparison of predicted rotor loads with wind tunnel rotor test results revealed the importance of using coupled modes and of choosing the most appropriate coordinate system to satisfy the hypothesis of time-invariant mode shapes.

80-1331

Rotor Blade Tip Shape Effects on Performance and Control Loads from Full-Scale Wind Tunnel Testing

R.H. Stroub, J.P. Rabbott, Jr., and C.F. Niebanck
Ames Res. Ctr., NASA Moffett Field, CA, J. Amer. Helicopter Soc., 24 (5), pp 28-35 (Oct 1979) 17 figs, 3 refs

Key Words: Rotors (machine elements), Blades, Rotor blades, Helicopter rotors, Fatigue life, Wind tunnel tests

A test of a full-scale four-bladed helicopter rotor was conducted in the NASA Ames Research Center Wind Tunnel to investigate performance, acoustics, and loads characteristics of a rotor with various tip planforms. The swept-tapered tip

was found to lessen control loads for the high advancing tip Mach number condition. Tip taper and sweep both were found to have a beneficial effect on the acoustic signature, with the swept-tapered tip being the quietest of the four shapes tested.

80-1332
Blade Vibration Frequency of Flexible Blade Auto Cooling Fans

S.V. Hoa
Dept. of Mech. Engrg., Concordia Univ., Montreal, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1564-1567, ASME (1979) 6 figs, 2 tables, 3 refs
(For primary document, see 80-1477)

Key Words: Blades, Fans, Automobiles, Natural frequencies, Mode shapes, Cylindrical shells, Finite element technique

The natural vibration frequencies and mode shapes of a curved blade are investigated. Finite element method is used where curved cylindrical shell finite elements are utilized to model the blade. Two types of boundary conditions are investigated; in one, one straight edge of the blade is supported along its complete length and in the other case, only a portion of this edge is supported. Blades of different radii of curvature are also examined.

80-1333
Blade-Row Interaction in an Axial-Flow Subsonic Compressor Stage

H.E. Gallus, J. Lambertz, and T. Wallmann
Inst. for Jet Propulsion and Turbomachines, Technical University Aachen, West Germany, J. Engr. Power, Trans. ASME, 102 (1), pp 169-177 (Jan 1980) 20 figs, 3 tables, 17 refs

Key Words: Blades, Compressor blades, Vibration excitation

This paper contains the results of the measurements of fluctuating pressures on the mid-span profile surfaces of both rotor and stator blades for several points of operation. The results of the measurements are evaluated with respect to the parameters involved, like Strouhal-number, reduced frequency, and circumferential Mach number. Emphasis is given to the establishment of correlations for the blade-row interaction and to the comparison of the measured pressure distributions with computed results according to well-known theoretical approaches.

BEARINGS

(Also see Nos. 1249, 1348, 1441)

80-1334
Dynamic Characteristics of the Perycycloid Bearing with Unsymmetrical Supply Pressure

W. Kaniewski and S. Strzelecki
Institut of Machine Des., Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 191-194, ASME (1979) 6 figs, 1 table, 5 refs
(For primary document, see 80-1477)

Key Words: Bearings, Oil film bearings, Oil film, Spring constants, Damping coefficients

The pericycloid bearing belongs to the multi-lobe bearing category, whereas with the use of the pressure supply it has features of hybrid bearing. Unsymmetrical supply pressure for individual working surfaces influences the damping properties of the oil film. Boundary bearing capacities have been determined taking into consideration the spring and damping properties of the oil film.

80-1335
Spring and Damping Coefficients of the Nonisothermal Oil Film

W. Kaniewski, S. Strzelecki, and W. Swiderski
Institut of Machine Design, Tech. Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 199-202, ASME (1979) 6 figs, 6 refs
(For primary document, see 80-1477)

Key Words: Bearings, Oil film bearings, Oil film, Spring constants, Damping coefficients

A comparison between isothermal and non-isothermal oil films shows substantial quantitative distinction in the pressure fields, and consequently in the bearing capacities. The spring and damping coefficients differ, too.

80-1336

Optimization of Rolling Element Profiles of Cylindrical Roller Bearings (Optimale Walzkorperprofilierung von Zylinderrollenlagern)

R. Schaude
Universität Karlsruhe, Germany, Konstruktion, 32 (1), pp 19-25 (Jan 1980) 13 figs, 4 refs
(In German)

Key Words: Bearings, Roller bearings, Optimization

A numerical method for the calculation of the optimum profiles of rolling elements of cylindrical roller bearings is presented. The optimum shape is not a true cylinder. Profiled ends of the roller elements reduce the stress concentrations at the end of roller-race contact, resulting in an increased life of the bearing. The theory is confirmed by experiment.

80-1337

The Stability of Flexibly Supported Hybrid Gas Journal Bearings

Z. Kazimierski and K. Jarzecki
Technical Univ. of Lodz, Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1626-1629, ASME (1979) 4 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Bearings, Gas bearings, Flexible foundations, Ring springs

Experimental investigations of the stability of externally pressurized gas bearing system elastically supported by means of rubber O-rings are performed. Dynamic properties of the O-rings are determined experimentally using a special test rig. The investigated rings are of the same geometry but made with rubber of different kinds. The experimental results of the gas bearing stability investigations are compared with results of theoretical calculations.

80-1338

Dynamic and Static Properties of Recessed Hydrostatic Journal Bearings by Small Displacement Analysis

W.B. Rowe
Liverpool Polytechnic, Liverpool L3 3AF, UK, J. Lubric. Tech., Trans. ASME, 102 (1), pp 71-79 (Jan 1980) 7 figs, 4 tables, 8 refs

Key Words: Bearings, Journal bearings, Whirling

Hydrostatic stiffness, hydrodynamic stiffness and squeeze damping coefficients for capillary, orifice and constant flow control are presented. It is demonstrated that the squeeze damping constant for the concentric condition may be obtained from a steady loading test for hydrodynamic stiffness.

80-1339

Stiffness and Damping Matrices of Multi-Sleeve Journal Bearings

N.H. Hien and M. Roszkowski
Technical Univ. of Thai Nguyen, Vietnam, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1364-1367, ASME (1979) 7 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Bearings, Journal bearings, Sleeve bearings, Stiffness coefficients, Damping coefficients

The paper presents a method of determining the stiffness and damping coefficients for the multi-sleeve bearings. The formulae of computation of these coefficients were programmed for digital computer for multi-sleeve bearings with k partial concentric sleeves. On the basis of presented method the numerical computations were carried out for a bearing with three concentric sleeves. In the experimental part the stiffness and damping coefficients for the same bearing with 3 sleeves were found on the test stand. The comparison of results was made.

80-1340

Oil Pressure Distribution in the Dynamically Loaded Slide Bearing

J.M. Stasiak
Institute of Machine Construction, Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 211-214, ASME (1979) 11 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Bearings, Slider bearings, Lubrication

This article deals with the method of calculating pressure distribution in a hydrodynamic slide bearing loaded dy-

namically. It was assumed that there is a laminar and isothermal flow of barotopical equivalent liquid which is rheologically homogeneous. The specific density of liquid is a function of pressure and amount of air in oil in the form of bubbles which are subject to isothermal changes. The results of numerical calculations for an infinitely long bearing has been presented graphically and compared with the solutions for a statically loaded bearing.

80-1341

An Experimental Investigation into the Rubber-Stabilization of an Externally-Pressurized Air-Lubricated Thrust Bearing

D.A. Boffey and D.M. Desai
Dept. of Mech. Engrg., Univ. of Edinburgh, Edinburgh, UK.
J. Lubric. Tech., Trans. ASME, 102 (1), pp 65-70 (Jan 1980) 15 figs, 1 table, 13 refs

Key Words: Bearings, Thrust bearings, Supports, Elastomeric dampers

Stability maps are presented for a circular thrust bearing which has a central feed hole and pocket and is flexibly supported on various rubber O-rings. Results obtained show that a substantial improvement in stability can be achieved compared with the normal fixed-pad arrangement. An earlier stability theory has been programmed with measured O-ring support data but qualitative agreement with experiment is attained only after modification of theory.

GEARS

(Also see Nos. 1264, 1406)

80-1342

Multiple Impacts of a Cylinder Between Two Planes and of the Meshing Teeth of a Pair of Gears

T. Hayashi, N. Nishi, T. Ohno, and F.R.E. Crossley
Tokyo Inst. of Tech., Res. Lab. of Precision Machinery and Electronics, Yokohama, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 350-353, ASME (1979) 10 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Gears, Impact response (mechanical), Impact pairs, Cylinders

An experimental investigation of the movement of a steel cylinder between two parallel plates moving harmonically is described. It is shown, that the mode of vibration is affected by the ratio of excitation amplitude and the amount of backlash, but not affected by the excitation frequency. A pair of meshing gears are tested also on a special gear tester.

80-1343

Effect of the Tolerance on the Tooth Load by Spur Gear Drives with Positive-Drive and Branching Power

K.-H. Vatterott
Braunfels, German Federal Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 345-349, ASME (1979) 5 figs, 18 refs
(For primary document, see 80-1477)
(In German)

Key Words: Gears, Spur gears

Spur gear drives with positive drive and branching power which have more than three intermediate wheels become centered in the stationary state. The differences in dimension which are present cause changes in the load on the component parts. Both static and dynamic effects occur.

80-1344

Specifying Gear Backlash

L.J. Smith
Invincible Gear Co., Detroit, MI, Mach. Des., 52 (3), pp 106-110 (Feb 7, 1980)

Key Words: Gears, Gear cutting

The required backlash in an assembled gearset is achieved by setting up controls that can be applied throughout the manufacturing process from gear cutting and inspection to assembly.

80-1345

Simulation of Gear Life

A. Kubo
Dept. of Mech. Engrg., Kyoto Institute of Technology, Matsugasaki, Sakyoku, Kyoto, Japan, Theory

of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1192-1195, ASME (1979) 5 figs, 28 refs
(For primary document, see 80-1477)

Key Words: Gears, Geometric effects, Error analysis, Failure analysis

The dynamic state of gears changes with time. The change of tooth form error is dependent on the factors such as actual value of dynamic force on tooth flank, surface condition of tooth flank, lubricating condition, thermal state of tooth flank and the strength of gear material. In this investigation such change of dynamic state of gears with running time is simulated on a computer.

80-1346

Dynamic Behaviour of a Mechanical System with Gear Transmission Error

A. Toda and G.V. Tordion
Pratt & Whitney Aircraft of Canada Ltd., Longueuil, Quebec, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1130-1133, ASME (1979) 7 figs, 17 refs
(For primary document, see 80-1477)

Key Words: Power transmission systems, Gears, Error analysis, Geometric imperfection effects

The effects of gear transmission error on the dynamic response of a torsional mechanical system are investigated. A new electronic apparatus was developed to record the numerical difference between the angular displacements of a pinion and a gear, thus yielding a precise measurement of the transmission errors. The mathematical model of the torsional system consisting of a set of second order nonlinear differential equations with variable coefficients is studied on a hybrid computer. The results are found to be in good agreement with the available experimental data.

80-1347

Effect of Gear Errors on Non-Linear Vibrations of a Gear-Train System

B. Kishor
Faculty of Engrg., Univ. of Jodhpur, Jodhpur, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1122-1125, ASME (1979) 2 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Gears, Torsional vibration, Geometric imperfection effects

The present paper deals with the analysis of the effects of gear errors on non-linear torsional vibrations of a gear-train. Kinetic and potential energy functions have been developed for the case under consideration. With the help of LaGrange's equations, the equations of motion are obtained. Modification of Krylov-Bogoliubov's method has been made to obtain solutions. Present solutions bring out certain results which may lead to important changes in the design of such systems.

80-1348

Whirl of Geared Systems Supported on Hydrodynamic Bearings

B.M. Hamad and A. Seireg
Univ. of Khartoum, Khartoum, Sudan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1109-1112, ASME (1979) 6 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Bearings, Gears, Whirling

The paper investigates the effect of gear constraint on the whirl of pinion shafts supported on fluid-film bearings. The analysis utilizes a phase-plane-δ simulation for determining the whirl trajectories. The effect of unbalance magnitude on the amplitude of whirl and instability of the motion is illustrated by numerical examples. Although idealized conditions are considered for illustration, the results show that the gear mesh has a stabilizing effect on the pinion rotor. The speed at onset of instability is found to increase with increasing gear ratio.

CLUTCHES

80-1349

Investigation of the Transient Process Arising in a Drive During Friction Clutch Engagement

A. Bodnar and S. Berczynski
Technical Univ. of Szczecin, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada,

pp 238-241, ASME (1979) 9 figs, 3 refs
(For primary document, see 80-1477)

Key Words: Clutches, Power transmission systems, Friction

The clutch engaging process is discussed taking into account the effects of variability of kinetic friction coefficient, clutch engaging force and a drive load. A proposed approach to the problem is illustrated with an example included in the paper.

COUPLINGS

(Also see No. 1437)

80-1350

Operational Axial Forces of Tooth Couplings

G Pahl

Technische Hochschule Darmstadt, German Federal Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 177-180, ASME (1979) 10 figs, 3 refs
(For primary document, see 80-1477)
(In German)

Key Words: Couplings, Axial force, Lubrication, Friction, Design techniques

Tooth couplings used as high speed couplings in turbo-arrangements and high-load couplings in crushing rolls are discussed.

FASTENERS

80-1351

Forces of Dynamically Loaded Fitted Bolts

I Janezic

Faculty of Mech. Engrg., Univ. of Ljubljana, Yugoslavia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 57-60, ASME (1979) 5 figs, 2 refs
(For primary document, see 80-1477)

Key Words: Bolts, Optimization

An endeavor of any design engineer is to obtain optimal dimensions of individual components of mechanism by determined load. It is especially in force for elements which are used in big quantities. By optimizing the proportion of the forces, which load fitted bolts and considering the allowed tolerances, the minimal dimension of the fitted bolt is obtained.

LINKAGES

(Also see No. 1448)

80-1352

On the Development of Criteria for the Prediction of Impact in the Design of High Speed Systems with Clearances

S. Dubowsky, J.M. Prentis, and R.A. Valero

Univ. of California, Los Angeles, CA, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 968-971, ASME (1979) 6 figs, 3 tables, 9 refs
(For primary document, see 80-1477)

Key Words: Joints (junctions), Machinery, Clearance effects, Impact response (mechanical)

Clearances within the connections of machines can lead to serious degradation of system performance: noise and vibration are increased, life and stability reduced, and wear and fatigue failures accelerated. These effects can be related to the forces generated by impacts within the clearances. In this study, this question is addressed using a model, termed the Planar Impact Ring Model. This model, while being relatively simple, contains the essence of the nonlinear characteristics of connections with clearances and yields insights into the phenomena of connection impacts.

80-1353

Predicting Impact Conditions Due to Bearing Clearances in Linkage Mechanisms

S.W.E. Earles and O. Kilicay

King's College, London Univ., UK, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1078-1081, ASME (1979) 6 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Clearance effects, Joints (junctions), Impact pairs, Noise generation

Clearances at connections of mechanical systems may allow contact to be momentarily lost between the interconnected elements resulting in impact loading, the generation of noise and deterioration of the bearing surfaces. Following some earlier work a zero-clearance analysis of the system has been used to develop empirical relationships for describing the occurrence and magnitude of the impact loading. These relationships are applicable to the system when only one bearing has a finite clearance and when two bearings have finite clearances.

80-1354

Squeeze Film Lubrication within the Impact Pair

R.G. Herbert and D.C. McWhannell
Naval Aircraft Materials Lab., RNAY Fleetlands, Gosport, Hampshire, UK, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1615-1618, ASME (1979) 6 figs, 1 table, 13 refs
(For primary document, see 80-1477)

Key Words: Joints (junctions), Impact pairs, Squeeze film dampers, Lubrication, Clearance effects

Studies of radiated noise levels show that for some classes of mechanisms, the joints are the major sources of parasitic vibration. The joint, in the form of an impact pair, has been analyzed in previous work by Dubowsky and Crossley and recently by Herbert and McWhannell but in none of these cases is the effect of the lubricant considered. Here the impact pair model developed by Crossley is extended to include the lubricant operating in a squeeze film regime and it is demonstrated that clearance in the joint and lubricant viscosity can significantly alter the joint dynamics.

80-1355

Resonant Fatigue Testing of Riveted Joints

R.H. Marloff
Westinghouse R & D Ctr., Pittsburgh, PA 15235, Experimental Mechanics, 20 (2), pp 37-43 (Feb 1980) 12 figs, 2 tables, 7 refs

Key Words: Joints (junctions), Blades, Turbine blades, Fatigue life, Fatigue tests, Test facilities

A special test facility was constructed for evaluating the fatigue strength of turbine-blade components under steady pullout and vibratory bending loadings. The application of this facility to the determination of the fatigue strength of a type of riveted connection employed on certain types of blades is described in this paper.

80-1356

The Sliding Dynamics of CV-Joints: Mathematical Modeling and Non-Linear Dynamical Equations

N. Bellomo and A.P. Orsi
Instituto di Meccanica Razionale, Politecnico, Torino, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 964-967, ASME (1979) 2 figs, 13 refs
(For primary document, see 80-1477)

Key Words: Joints (junctions), Power transmission systems, Mathematical models

This paper deals with the theoretical analysis of the dynamics of a particular transmission system constituted of two elements sliding and rotating, under external forces, along and around their respective axes. The two elements being connected by a CV-joint. In particular, a mathematical model for the analysis of the system and of the behavior of the CV-joint is here proposed and the equations of the dynamics of the system itself are deduced on the basis of the model.

80-1357

The Use of Flexible Members in Technique

G.G. Vassin and V.V. Levanidov
Dept of Theory of Machines and Mechanisms, Chelyabinsk Polytechnical Inst., USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1376-1379, ASME (1979) 2 figs, 7 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Linkages, Dynamic structural analysis

The present paper deals with widening the concept of "flexible" members so far referred to the belt and chain transmission only. The new concept, i.e. flexible kinetic couple is introduced as a movable group with an infinite number of degrees of freedom. Mention is made of those fields of technology, where flexible members such as robots, air-cushion apparatuses, and dynamic clutches are actively used. A classification of flexible links according to their structural and functional properties is provided. The authors developed the method of calculating the links mentioned above, which is based on the soft shell theory.

80-1358

On Influences of Clearance and Friction Effects to the Behaviour of Transfer Mechanisms

G. Bogelsack, V. Ifrim, and H. quoc Viet
Technische Hochschule Ilmenau, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 972-975, ASME (1979) 5 figs, 7 refs
(For primary document, see 80-1477)
(In German)

Key Words: Mechanisms, Error analysis, Linkages, Clearance effects, Friction, Integral equations

Dynamic behavior of mechanisms is calculated by means of integration methods and linear vector methods. Computerized real transfer functions are confirmed by experiment. The paper discusses errors arising in mechanisms and concentrates on influences of clearance, friction and elasticity in calculation.

80-1359

Dynamics Analysis of Specific Devices with Flexible Links by Finite Element Method

A. Gulbinas, A.-P. Kavolelis and A. Jakstas
Civil Engrg. Inst., Vilnius, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 976-979, ASME (1979) 3 figs, 3 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Linkages, Finite element technique

Coaxial devices involving spring elements under strain, carrying specific centrifugal weights have found positively wide application in rotation transmitting systems. A method of finite elements has been adequately worked out and successfully applied to the systems given. As a result of the analysis the algorithms to express main characteristics of the devices has been derived.

80-1360

Vibration Analysis of Four-bar Linkage with Elastic Links (1st Report, Transverse Vibration of Overhanging Coupler)

T. Furuhashi, M. Saito, and N. Morita
Faculty of Engrg., Shizuoka Univ., Bull. JSME, 22 (174), pp 1826-1833 (Dec 1979) 14 figs, 1 table, 5 refs

Key Words: Linkages, Flexural vibrations, Lumped parameter method, Finite difference technique

The continuous mass distribution of an overhanging coupler in a four-bar linkage is replaced by a lumped mass model, and the ordinary differential equations of motion for transverse vibration of the coupler are derived employing finite difference approximations. Comparison shows very good agreement between the numerical solutions and the experimental results for the coupler with an overhanging end at crank side in a crank-lever mechanism.

80-1361

Vibrations of Planar Linkages with Elastic Links

H. Dresig
Technische Hochschule, DDR 90 Karl-Marx-Stradt PSF 964, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979. Montreal, Canada, pp 98-101, ASME (1979) 4 figs, 8 refs
(For primary document, see 80-1477)
(In German)

Key Words: Linkages, Vibration response, Algorithms, Computer programs

The relations between dynamic forces and motions in plane mechanisms with a rotating drive-link are described. A universal algorithm to determine the periodic coefficients of the linear differential equations is described. The computer program, based of this algorithm, allows the calculation of vibrations in mechanisms with n degrees of freedom. Efficiency of the algorithm and of the computer program is illustrated by an example.

80-1362

Improving Dynamic Characteristics of a Cam-Follower Mechanism Through Finite Difference Techniques

R.N. Kanango and N. Patnaik
Dept. of Mech. Engrg., Univ. College of Engrg., Burla, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 591-594, ASME (1979) 3 figs, 4 tables, 3 refs
(For primary document, see 80-1477)

Key Words: Mechanisms, Cams, Cam followers, Design techniques, Finite difference technique

For a cam with suitably controlled machining tolerances, fluctuations of acceleration yield unwanted motion and extra dynamic forces on the follower. These fluctuations can be removed by modifying the cam profile in accordance with displacements obtained through finite difference techniques. A parabolic cam with abrupt fluctuations of acceleration has been chosen for illustrating the method.

80-1363

Periodic Response of High-Speed Cam Mechanism with Flexible Follower and Camshaft Using a Closed-Form Numerical Algorithm

A. Midha, M.L. Badlani, and A.G. Erdman
Pennsylvania State Univ., Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1311-1314, ASME (1979) 1 fig, 10 refs
(For primary document, see 80-1477)

Key Words: Cams, Cam followers, Camshafts, Periodic response

The dynamic response of a flexible cam-follower system, taking into account the flexibility of the camshaft, has been investigated in the past. The single degree-of-freedom linear second order differential equation of motion developed for the flexible follower has been shown to possess time-dependent periodic coefficients. Conventionally, each cycle of the cam motion is treated as a pulse and the follower's motion during the pulse application, and after the excitation has subsided, has been found. The basic assumption in these works, however, has been that the residual vibration damps out during the dwell period and does not carry over to the next motion cycle. This paper forgoes this assumption and suggests a closed-form numerical algorithm to compute the periodic response.

80-1364

Changes of the Dynamic Properties of the Real Cam Profile During Its Wear

B. Bialkowicz, T. Klimowicz, and M. Swietlik
Technical Univ. of Warsaw, Inst. for Aircraft Engrg. and Applied Mechanics, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 984-987, ASME (1979) 6 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Cams, Digital simulation, Mathematical models, Wear

This paper presents the results of investigations of dynamic properties of cam profiles obtained from the endurance tests carried out on the particular I.C. engine and the 16 mr.. film projector. The experimental acceleration runs, as well as the noise level for the projector, have been measured and the frequency analysis has been made. Practical instructions for the designers and for the users of these mechanisms have been elaborated.

80-1365

On the Modelling of Impacts of Two Elastic Bodies Having Flat and Cylindrical Surfacer with Application to Cam Mechanisms

F.R.E. Crossley, A. Oledzki, and W. Szydlowski
Dept. of Mech. Engrg., Univ. of Massachusetts, Amherst, MA, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1090-1092, ASME (1979) 5 figs, 3 refs
(For primary document, see 80-1477)

Key Words: Cams, Impact pairs, Experimental data, Mathematical models

This work deals with modeling of impacts of two elastic bodies having flat and cylindrical surfaces. In the first part of the work, experiments performed on a special test rig are described. The results of the experiments were utilized in developing a discreet mathematical model of impact. This model was later used in investigation of dynamics of the positive-return cam mechanism with backlash.

80-1366

Optimisation of Picking Cam Design Through Dynamic Studies

P.B. Jhala and C.G. Venkataramanan
Abmedabad Textile Industry's Res. Assn., Ahmedabad, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 992-995, ASME (1979) 5 figs, 6 refs
(For primary document, see 80-1477)

Key Words: Cams, Optimization, Textile looms, Measurement techniques

This paper presents work on development of an optimum design of the picking cam profile through theoretical analysis and dynamic studies. Sophisticated measurement techniques were developed and used for dynamic studies. The mechanical performance of different cams under dynamic conditions were compared.

80-1367
Dynamics of Indexing Cam Mechanism and Speed-Up of Its Motion
M. Takano and S. Toyama
Faculty of Engrg., Univ. of Tokyo, Tokyo, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1408-1411, ASME (1979) 12 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Cams, Vibration excitation, Vibration control

In the intermittent motion of indexing cam mechanism, the residual vibration is investigated quantitatively, caused by backlash, contact stiffness of cam and follower, and the rotational fluctuation of input axis. A new method to eliminate the residual vibration is proposed where the electromagnetic brake set on the mechanism is controlled so as to work only a few mili-seconds.

VALVES
(See No. 1440)

SEALS

80-1368
Choose the Right Seal
K.S. Panesar
Black Sivalls & Bryson, Inc., Houston, TX, Hydrocarbon Processing, 60 (1), pp 107-110 (Jan 1980) 4 figs, 2 tables, 1 ref

Key Words: Seals (stoppers), Pumps

Many pump seal failures in petrochemical plants or refineries can be traced to improper seal selection on pump application. Installation and operation of various types of seals are discussed.

80-1369
Dynamic Analysis of Rotary Engine Apex Seals
A.R. Martin and J.P. Sadler
Exxon Chemical Co., Linden, NJ, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1240-1243, ASME (1979) 5 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Seals (stoppers), Rotating structures, Engines

This study investigates the dynamic behavior of the rotary engine apex gas seal. The principle of d'Alembert is applied to develop a general mathematical model for dynamic analysis. Analyses for different operating conditions and for different seal designs are conducted.

80-1370
On the Analysis of Dynamics of Sealing Elements
A. Rovetta
Inst. of Mechanics of Machines, Polytechnic of Milan, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 947-950, ASME (1979), 10 figs, 6 refs
(For primary document, see 80-1477)

Key Words: Seals (stoppers), Reciprocating engines

This paper deals with some aspects of the dynamic behavior of sealing elements used for piston rings in reciprocating machines. The motion of piston rings is examined; the results of the research are applied to non metallic rings, used in reciprocating unconventional engines like Stirling engines.

STRUCTURAL COMPONENTS

CABLES
(See No. 1407)

BARS AND RODS

80-1371
On the Parametric Excitation of a Tensioned Bar with Initial Curvature

R.L. Carlson, H.C.T. Lo, and R.P. Briley
Georgia Inst. of Tech., Atlanta, GA 30332, Intl. J. Mech. Sci., 22 (1), pp 59-65 (1980) 3 figs, 4 refs

Key Words: Bars, Parametric excitation, Initial deformation effects, Curved beams

The parametric excitation of a tensioned bar with initial curvature is discussed. A model for the behavior is developed and the nonlinear equations for determining the secondary and principal regions of resonance are derived. Solutions to the equations are obtained and amplitude vs. frequency data are presented.

BEAMS

80-1372
Finite Element Method for the Vibration Frequency of a Curved Beam with Tip Mass
S.V. Hoa
Mech. Engrg. Dept., Concordia Univ., Montreal, Quebec, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 90-93, ASME (1979) 5 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Beams, Curved beams, Mass-beam systems, Finite element technique, Natural frequencies

The vibration frequency of a curved beam with tip mass is investigated using finite element method. Both the normal and tangential displacements are approximated by polynomials that take rigid body motion into account. The effect of the tip mass is incorporated into the mass matrix. The results show that the curvature has a slight effect on the first mode natural frequencies but it has great influence on the higher frequencies and that the coupling effect between the curvature and the tip mass is insignificant.

80-1373
Vibration and Response of Nonuniform Rotating Beams with Discontinuities
D.H. Hodges
Aeromechanics Lab., U.S. Army Res. and Tech. Labs. (AVRADCOM), J. Amer. Helicopter Soc., 24 (5), pp 43-50 (Oct 1979) 12 figs, 15 refs

Key Words: Beams, Rotating structures, Natural frequencies, Mode shapes, Ritz method

The direct analytical method of Ritz is applied to solve for the natural frequencies, mode shapes, and response of a nonuniform rotating beam with discontinuities in bending stiffness and mass distribution. Unlike conventional modal methods, however, separate series of admissible functions are assumed within segments of the beam that are free from discontinuities in stiffness and mass properties. Results are obtained that converge to the exact solution so that bending moment and shear force distributions can be expressed simply and accurately in terms of derivatives of the displacement. Results from this method are compared with those from conventional Rayleigh-Ritz methods and found to be superior in terms of accuracy and simplicity.

FRAMES AND ARCHES

80-1374
On the Stability of Small-Frame Vibration for Non-Uniform Reduction Linkages
R. Schraut
Institut f. Getriebetechnik und Maschinendynamik, Technische Hochschule, Aachen, German Federal Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 412-415, ASME (1979) 4 figs, 7 refs
(For primary document, see 80-1477)
(In German)

Key Words: Frames, Stability, Computer programs

This paper investigates the parametrically excited small vibrations of the elastically mounted and damped frames supporting plane mechanisms with rigid links. To illustrate the problem plane four-bar linkages with uniform crank rotation have been considered in this paper. Discussion on certain approximations for quick computation is presented.

PANELS
(See Nos. 1305, 1381)

PLATES

80-1375
Transient and Pseudo-Transient Analysis of Mindlin Plates

A. Pica and E. Hinton
Dept. of Civil Engrg., Univ. College of Swansea, Swansea, Wales, UK, Intl. J. Numer. Methods Engr., 15 (2), pp 189-208 (Feb 1980) 17 figs, 24 refs

Key Words: Plates, Initial deformation effects, Transverse shear deformation effects, Rotatory inertia effects, Mindlin theory, Finite element technique

A unified approach is presented for the static and transient dynamic linear and geometrically nonlinear analysis of Mindlin plates including initial imperfections. The effects of transverse shear deformation and rotatory inertia are automatically taken into account. A finite element idealization is adopted and the quadratic Lagrangian Mindlin plate element is used together with selective integration. Several numerical examples are presented and compared with results from other sources.

80-1376
Nonlinear Vibrations of Thick Plates Using Mindlin Plate Elements
K.K. Raju and E. Hinton
Vikram Sarabhai Space Centre, Trivandrum, India, Intl J Numer Methods Engr., 15 (2), pp 249-257 (Feb 1980) 1 fig, 8 tables, 12 refs

Key Words: Plates, Nonlinear response, Finite element technique, Mindlin theory

Large amplitude vibrations of Mindlin plates are studied using Lagrangian, isoparametric, quadrilateral elements with selective integration. Square, rectangular, circular and elliptical plates with clamped and simply supported boundary conditions are considered.

80-1377
Random Vibration of Mechanisms on Plates
S.H. Crandall and A.P. Kulvets
Dept. of Mech. Engrg., Massachusetts Inst. of Tech., Cambridge, Ma, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1568-1571, ASME (1979) 3 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Plates, Mechanisms, Mountings, Equipment mounts, Random vibration, Cross correlation technique

Random vibrations of mechanisms supported on plates, and of plates themselves, are investigated. Computer procedures for solving these problems are described and the results of several cases are given. Approximate analytical methods are also described and illustrated. The distribution of mean-square response depends on the number and location of exciting forces and on the joint statistical properties of the random force processes. The importance of the cross-correlations between excitations is pointed out.

SHELLS
(Also see No. 1332)

80-1378
Plastic Response of Orthotropic Spherical Shells Under Blast Loading
S. Anantha Ramu and K.J. Iyengar
Dept. of Civil Engrg., Indian Inst. of Science, Bangalore, India, Nucl. Engr. Des., 55 (3), pp 363-373 (Dec 1979) 8 figs, 1 table, 10 refs

Key Words: Shells, Spherical shells, Blast loads, Plastic deformation

The plastic response of a segment of a simply supported orthotropic spherical shell under a uniform blast loading applied on the convex surface of the shell is presented. The blast is assumed to impart a uniform velocity to the shell surface initially. Numerical results presented include the permanent deformed configuration of the shell and the total time of shell response for different degrees of orthotropy. Conclusions regarding the plastic behavior of spherical shells with circumferential and meridional stiffening under uniform blast load are presented.

RINGS
(See No. 1337)

PIPES AND TUBES

80-1379
Vibration of a Pipe Conveying Fluid
M. Paz
Univ. of Louisville, Louisville, KY, Theory of Machines and Mechanisms, Proc. of 5th World Congress,

Vol. II, July 8-13, 1979, Montreal, Canada, pp 1486-1489, ASME (1979) 1 fig, 6 refs
(For primary document, see 80-1477)

Key Words: Pipes (tubes), Fluid-filled containers, Fluid induced excitation

In this paper the general dynamics matrix for a pipe containing a flowing fluid is obtained directly from the corresponding differential equation. Numerical solutions to this equation are discussed. It is shown that the first two terms of the resulting series, which are usually derived from static displacement functions, correspond respectively to the elastic stiffness matrix and the consistent mass matrix. A third term, corresponding to the fluid velocity, as well as higher order terms up to the second order, are obtained explicitly. Also a discussion is presented for establishing the region of convergence of the series. Standard techniques may then be used to assemble the system dynamic matrix for network of pipes conveying fluids. Any variation in cross sectional characteristics including the presence of lumped masses is systematically accounted without complicating the analysis. With the inclusion of the Coriolis term the element dynamic matrix is presented implicitly. By neglecting the Coriolis term, the element dynamic matrix is obtained explicitly in terms of structural characteristics of the pipe and the velocity of the fluid.

80-1380
Sound Isolation of Pipes with Elliptical Cross-Section (Schalldämmung von Rohren mit elliptischem Querschnitt)
M. Heckl and V. Ramamurti
Institut f. Technische Akustik der Technischen Universität Berlin, Berlin, Germany, Acustica, 43 (5), pp 313-318 (Dec 1979) 4 figs, 8 refs
(In German)

Key Words: Pipes (tubes), Acoustic insulation, Noise reduction

It is known that the low frequency sound isolation of pipes varies from pipe to pipe even if the cross-section seems to be the same. To explain this effect the equations of motion of elliptic pipes are given and the amplitudes of the low order modes are calculated.

BUILDING COMPONENTS

80-1381
The Steady State Transmission of Sound at Normal and Oblique Incidence through a Thin Panel Backed by a Rectangular Room - A Multi-Modal Analysis
R.W. Guy
Centre for Building Studies, Concordia Univ., Montreal, Canada, Acustica, 43 (5), pp 295-304 (Dec 1979) 7 figs, 2 tables, 16 refs

Key Words: Rectangular panels, Panels, Sound transmission, Modal analysis, Windows, Walls

A multimodal solution is presented for the airborne sound transmission through a rectangular flexible panel backed by a finite rectangular cavity. Expressions for panel velocity and pressure developed within the cavity when subjected to external plane waves at varying angles of incidence are also presented. Reconsideration of an existing modal coupling factor for the case of a vibrating panel partially covering a wall is given.

ELECTRIC COMPONENTS

MOTORS

80-1382
Dynamical Analysis of a Machine with a View to its Characteristic
J. Zahradka
CKD Praha - Research Institute for Diesel-Locomotives, Praha, Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 231-233, ASME (1979) 4 figs, 2 refs
(For primary document, see 80-1477)

Key Words: Motors, Mathematical models, Dynamic structural analysis

The theoretical analysis presented in this paper is concerned with a practical dynamic problem in which the behavior of one electro-mechanical system is investigated. In this case the dynamic model forms a torsional two-mass system where, on the input end, the torque of the electric motor and on the output end the nonlinear resistance function are considered.

GENERATORS

80-1383
Maintaining Peace in the Office
Paxman Diesels Ltd., Noise Control Vib. Isolation, 10 (9), pp 363-365 (Nov/Dec 1979) 4 figs

Key Words: Electric power plants, Buildings, Noise reduction, Vibration control

The isolation of all air-borne and structure-borne vibration and noise transmitted from a diesel power generator installed on the top floor of an eight-story office building is described.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 1255, 1260, 1261, 1264 1273, 1293, 1323, 1383, 1420, 1430)

80-1384
Power Series for the Reverberation Time
W.B. Joyce
Bell Labs., Murray Hill, NJ 07974, J. Acoust. Soc. Amer., 67 (2), pp 564-571 (Feb 1980) 5 figs, 33 refs

Key Words: Enclosures, Acoustic absorption, Power series method, Reverberation chambers

The reciprocal of the reverberation time T is expressed as a power series in the absorptivity of the enclosure. It is shown that T bears a simple relation to the gain g of a laser, and, thus, existing evaluations of either g or T are immediately interpreted as evaluations of the other.

80-1385
The Relation Between Sound Power Level and Sound *Pressure Level Outside of Laboratories*
T.J. Schultz
Bolt Beranek and Newman, Inc., 50 Moulton St., Cambridge, MA 02138, Noise Control Engr., 14 (1), pp 24-29 (Jan/Feb 1980) 8 figs, 2 tables, 16 refs

Key Words: Sound pressure levels, Sound power levels

Rather than attempting to settle the question of whether the sound output of mechanical devices is better expressed in terms of sound power level or sound pressure level, the relationship between these quantities in spaces that have not been specifically designed to be reverberation rooms is considered. It is concluded that once the noise of a piece of equipment has been measured, caution must be exercised in how the data are used.

80-1386
Scattering of Stationary Acoustic Waves by an Elastic Obstacle Immersed in a Fluid
A. Bostrom
Inst. of Theoretical Physics, Fack, S-402 20 Goteborg, Sweden, J. Acoust. Soc. Amer., 67 (2), pp 390-398 (Feb 1980) 8 figs, 15 refs

Key Words: Sound waves, Acoustic scattering

The scattering of stationary acoustic waves by a bounded elastic obstacle in an inviscid fluid is considered. The developed formalism is an extension of the transition matrix method, which has been given by Waterman for acoustic, electromagnetic, and elastic scattering.

80-1387
Study of the Elastic Constants of Crystals and the Problem of Surface Waves Over Liquid and Crystalline Layers
S. De
Old Engrg. Office (Qrs.), Santiniketan, Birbhum, W. Bengal, India, J. Phys. Earth, 27, pp 71-97 (1979) 4 figs, 4 tables, 44 refs

Key Words: Wave propagation, Elastic waves

The wave propagation in crystalline media plays a very significant role in seismology as well as in crystal physics. To investigate such problems, we first study the elastic constants of crystals of different classes and groups. The problem of the propagation of Rayleigh waves in a system consisting of a liquid layer of finite depth overlying a semi-infinite half-space of orthorhombic and cubic crystals is solved. In the limiting cases, Stoneley waves are discussed. The dispersion equations

are derived and phase and group velocities of the waves are calculated as functions of wave number. Some interesting results are presented. The study of such waves brings some special features in seismology if certain part of the Earth is supposed to be composed of crystalline material.

80-1388
Problem of Surface Waves Over Liquid and Crystalline Layers. II.

S. De
Old Engrg. Office (Qrs.), Santiniketan, Birbhum, W. Bengal, India, J. Phys. Earth, 27, pp 99-129 (1979) 10 figs, 5 tables, 17 refs

Key Words: Wave propagation, Elastic waves

The problem of the propagation of Rayleigh waves in a system consisting of a liquid layer of finite depth overlying a semi-infinite half-space of monoclinic crystal is solved. The same problem in a hexagonal crystalline medium overlying an orthorhombic, cubic and monoclinic crystal is considered. The dispersion equations are derived and discussed. Some limiting cases are considered. Lastly, the effects of gravity on the wave propagation in crystalline media are investigated.

80-1389
Some Remarks on the Problem of the Use of Correlation Methods for the Analysis of Acoustic Parameters of Enclosures

G. Brzozka
Technische Hochschule Zielona Gora, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 424-427, ASME (1979) 5 figs, 8 refs
(For primary document, see 80-1477)
(In German)

Key Words: Signal processing techniques, Correlation techniques, Spectrum analysis, Acoustic spectra

A method for the evaluation of acoustic signals of a certain spectrum characteristic is presented which is to be used in the determination of acoustic parameters of closed spaces. The method provides an opportunity for a wider application of correlation method.

80-1390
Analytical Method to Predict Noise Radiation from Vibrating Machine Systems

N.D. Perreira and S. Dubowsky
Dept. of Mech. Engrg., Univ. of Texas at Austin, Austin, TX 78712, J. Acoust. Soc. Amer., 67 (2), pp 551-563 (Feb 1980) 11 figs, 1 table, 38 refs

Key Words: Machinery vibration, Noise generation, Noise prediction, Mathematical models

A fundamental study of noise generation in high-speed mechanical systems is undertaken. The objective being the development of modeling techniques for the prediction of mechanical system noise levels. Recently developed dynamical procedures are used to obtain the motions of linked mechanical systems with elastic elements and connection clearances. The ranges of critical system parameters are identified and classical acoustical analysis methods are used in determining the most significant acoustic sources. Detailed acoustic models are analytically developed for these significant sources. These methods and models are then used to predict the farfield radiation of a simple, yet representative, mechanical system; an elastic link with connection clearances in a nominal motion container.

80-1391
Identification of Vibroacoustic Effects in Mechanisms

K. Tomaszewski
Univ. of Mining and Metallurgy, Kraskow, Mickiewicza, Poland, *Theory of Machines and Mechanisms*, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 922-925, ASME (1979) 6 figs
(For primary document, see 80-1477)

Key Words: Machinery, Machinery noise, Machinery vibration, Noise generation, Vibration generation

Dynamic processes in mechanisms are a direct cause of vibroacoustic processes forming in them. Vibration energy has its source in kinematic pairs and spreads throughout the mechanism. The cause of vibration and noise was analyzed, also the mechanism with higher and lower pairs was presented. It has been attempted to systematize the problems and initiatives concerning determination of effective methods of evaluation of their vibroacoustic properties. There was a presentation of method of identification the vibroacoustic effect.

80-1392
Influences of Printing Paper on Noise of Impact Printer

N. Nishiwaki, S. Hori, and M. Tsutsumi
Tokyo Univ. of Agriculture and Tech., Koganei-City, Tokyo, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 914-917, ASME (1979) 10 figs, 1 table, 4 refs
(For primary document, see 80-1477)

Key Words: Printing, Noise generation

Impact printers are generally attached to the mini-computers which are widely used in many fields. There is an ever-growing demand for decreasing the impact noise of the printer. Therefore, in this paper, the magnitude of the noise generated by the printing paper is experimentally investigated by *using a simplified model of impact printer and facts found* are described.

SHOCK EXCITATION

(Also see Nos. 1300, 1308, 1353)

80-1393

A Schlieren Probe Method for the Measurement of the Refractive Index Profile of a Shock Wave in a Fluid

G.P. Davidson and D.C. Emmony
Dept. of Physics, Univ. of Tech., Loughborough, Leicestershire LE11, 3TU, UK, J. Phys. E. (Sci. Instr.), 13, pp 92-97 (Jan 1980) 10 figs, 17 refs

Key Words: Shock waves propagation

A technique is described for studying the refractive index profile of a shock wave in a fluid. The time variation of the *deflection of a narrow probe laser beam which is traversed* by the shock wave is compared with the theoretical deflection for a model refractive index profile obtained by computer ray tracing. The technique has been applied to the measurement of the pressure in a shock wave generated by *the impact of a focused carbon dioxide laser pulse on a* water surface.

80-1394

Some Recent Developments in the Prediction of Shock Interaction Phenomena at Hypersonic Speeds

D.H. Crawford
NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-80115, L-12669, 41 pp (Oct 1979) N79-33437

Key Words: Shock waves

The shock strengths for which either Edney type I or type II *shock interference patterns can occur when two oblique* shocks of opposite families intersect were determined graphically at Mach 10 by using logarithmic shock polar diagrams. The theoretical region of overlap for the two types of interaction was investigated by observing in the Schlieren system *of the Langley 15-inch hypersonic flow apparatus the inter*section of oblique shocks generated by two sharp 10 degree wedges as the wedge angles of attack and their relative positions were altered. A range of shock strengths for which either of the two interference patterns can exist was demonstrated.

80-1395

Crash Victim Simulations - Their Use and Validation

D.H. Robbins
Univ. of Michigan - HSRI, Ann Arbor, MI, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1172-1174, ASME (1979) 19 refs
(For primary document, see 80-1477)

Key Words: Collision research (automotive), Crash victim simulation, Anthropomorphic dummies, Computer programs

This paper discusses the following three subjects: two- and three-dimensional lumped-mass linkage representations of the interaction of a crash victim with an injury-producing environment; the use of such models; and their validation.

VIBRATION EXCITATION

(Also see Nos. 1260, 1321, 1391, 1413, 1457, 1465)

80-1396

Dynamics Problems of Heavy Duty Vibratory Systems

V.N. Poturaev
Inst. of Geotechnical Mechanics, Academy of the Ukrainian SSR, Dniepropetrovsk, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada,

pp 1498-1501, ASME (1979) 5 figs, 8 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Machinery vibration, Mathematical models

This paper examines the nature of problems arising in the design (development) of heavy vibration inducing machines and mechanisms, interacting with applied load and the source of energy. It examines questions on the existence of stable regimes in the machine with two self-balancing vibration inducers during the vibro-transmission of a heavy piece of material and a layer of granular media. Presented are results of mathematical modeling and experimental investigation of a two-mass system.

80-1397

Self-Excited Oscillations in Rectilinear Mechanical Systems

D. Filipov
Lehrstuhlleiter f. Fertigung und Werkzeugmaschinen Hochschule f. Lebensmittelindustrie, Plovdiv, Bulgaria, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 432-435, ASME (1979) 6 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Self-excited vibrations, Mechanical systems

The existing methods of quantitative evaluation of fundamental variables of the process of self-excited oscillations cannot be put into practice since a large number of the input quantities can be obtained only experimentally and this is not feasible when designing new machines.

80-1398

On the Self Synchronization of Mechanical Vibrator Due to the Impact

J. Inoue, Y. Araki, and S Miyaura
Faculty of Engrg., Kyushu Univ., Fukuoka, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 420-423, ASME (1979) 2 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Vibrators (machinery), Synchronous motors, Stability

This paper deals with self-synchronization of an elastically suspended mechanical vibrator, impacting upon an energy absorbing surface. It is shown that two unbalanced rotors rotate with the same mean absolute angular velocity, in spite of the absence of any direct connections between two rotors. The stability of this type of motion is analyzed in detail. Experimental results for this type of device are compared with a theoretical solution obtained from Schur's criteria.

80-1399

Identification of Oscillatory Systems with Harmonic Packet of Entry

A.A. Martynyuk and N.P. Plahtienko
Inst. of Mechanics of the Academy of Sciences, Ukrainian SSR, Kiev, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 118-121, ASME (1979) 8 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Vibratory tools, Dynamic structural analysis

The principle is presented of the packet input for design of dynamic systems ensuring the required output with the assigned input. Procedure is proposed for determination of dynamic characteristics of vibratory systems of machines and instruments on the basis of experimental data obtained under the action of packet of harmonic inputs. On the basis of approximate analytical relations of the theory of asymptotic methods of non-linear mechanics, expretions are derived for determinations of inertial, hardness and dissipative characteristics of vibratory systems.

80-1400

Vibratory Power Losses and Delivery to Rock During Rotary-Vibratory Drilling: Part I: Theory

D.C. Ohanehi and L.D. Mitchell
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061, J. Mech. Des., Trans. ASME, 102 (1), pp 102-109 (Jan 1980) 2 figs, 29 refs

Key Words: Drills, Vibratory tools

This paper explores a possible theoretical basis for the failure of attempts to develop rotary-vibratory drilling units. With the critical needs in geothermal blast hole excavation and oil exploration, this nation cannot overlook the possibility of

accelerating the drilling process by factors of 2 to 20 over the conventional rotary drilling rates. This paper develops the theory for the dynamic response of a vibrating drill string in a viscous drilling fluid with the energy lost to shear work.

80-1401
Vibratory Power Losses and Delivery to Rock During Rotary - Vibratory Drilling: Part II: Application

L.D. Mitchell and D.C. Ohanehi
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061, J. Mech. Des., Trans. ASME, 102 (1), pp 110-114 (Jan 1980) 5 figs, 17 refs

Key Words: Drills, Vibratory tools

This paper applies the theoretical solution developed in Part I of this paper to a rotary-vibratory drilling unit. The theory developed and applied in these papers explains possible causes for the failures of such devices to perform properly in the vertical vibratory mode. This paper predicts improved performance based upon system design changes. Power delivery as a function of depth is studied. Power delivery problems at great depths are uncovered. Further system redesign is suggested. The redesign implementation in the model results in recovery of the power delivery capability to the rock.

80-1402
Vibrating Spatially Periodic Structures with Simply Supported and Guided Ends

P.H. Denke
Douglas Aircraft Co., Long Beach, CA, SAE Paper No. 791064, 16 pp, 5 refs

Key Words: Periodic structures, Natural frequencies, Mode shapes

A spatially periodic structure is a longitudinal array of identical substructures. A method of free and forced vibration analysis of periodic structures with simply supported and guided ends is presented. The computational effort required roughly equals the effort to analyze a single substructure. All natural modes and frequencies of an extensive structure can be found from a characteristic equation of equal order to the degrees of freedom on one substructure boundary. A modal reduction further simplifies the computations; applications are presented. The method is expected to be useful in structural vibration, sound transmission, and sonic fatigue analysis.

80-1403
Lateral Response Spectra of Longitudinally Rapped Thin Elements

D. Juricic and G. Herrmann
Univ. of Texas, Austin, TX, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 428-431, ASME (1979) 5 figs, 9 refs
(For primary document, see 80-1477)

Key Words: Dynamic buckling, Lateral response, Spectrum analysis, Materials handling equipment, Pulse excitation

This paper analyzes the lateral response spectra of thin elements to a longitudinal rapping pulse as a function of the pulse level, the pulse duration, and the initial imperfections of the element. The response spectra due to a longitudinal rapping of thin elements are of interest in powder handling machines and devices where the rapping-induced vibration reduces the contact friction at the solid-powder interface.

80-1404
Dynamics of Molten Metal Weighing Devices

E.S. Sidash
All-Union Scientific Research Tube Institute, Dnepropetrovsk, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 700-701, ASME (1979) 4 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Measuring instruments, Equations of motion

It is shown that the weight-measuring system of the molten metal weighing device is an oscillating system with a slow changing mass, low non-linearity and the presence of a jet force. The equation of the system is solved for the relative motion, and its behavior is investigated in the case of per unit deviation.

MECHANICAL PROPERTIES

DAMPING

(Also see Nos. 1320, 1341, 1414, 1416, 1422)

80-1405
Determination of Optimal Dampers in Driving Systems

F. Holzweibig and S. Liebig
Sektion Grundlagen des Maschinenwesens, Technische Universitat Dresden, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 314-317, ASME (1979) 2 figs, 13 refs
(For primary document, see 80-1477)
(In German)

Key Words: Optimization, Vibration dampers, Torsional vibration, Drive line vibrations

The optimization of torsional vibration damper parameters of drive systems is investigated and the functions describing the quality of the system are discussed. The damper is represented by a linear damped spring-mass system, coupled to a multi degree of freedom system. The results of the numerical investigation are given.

80-1406

On a Planetary Gear Servo-Damping Unit

Y. Okada and T. Nakada
Ibaraki Univ., Hitachi, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1126-1129, ASME (1979) 8 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Vibration damping, Active damping, Torsional vibration, Critical speeds, Gears

This paper reports the results of an experimental investigation of an electro-hydraulic torsional servo-controlled damping unit. The damper is intended to provide supplementary damping for the torsional vibration system passing through the critical rotating speed.

80-1407

Effect of Test Clamp Weight on the Evaluation of Stockbridge Damper Performance

M.S. Dhotarad, N. Ganesan, and B.V.A. Rao
Machine Dynamics Lab., Dept. of Applied Mechanics, I.I.T., Madras, India, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 943-946, ASME (1979) 4 tables, 4 refs
(For primary document, see 80-1477)

Key Words: Dampers, Vibration dampers, Cables (ropes), Transmission lines, Wind-induced excitation

The present investigation deals with the effect of weight of the clamp on the characteristics of the damper and its influence on a determination of quantities like maximum micro strain of the transmission cable. Both theoretical and experimental investigations are carried out for studying this effect.

80-1408

Dynamic Properties of Elastomer Cartridge Specimens Under a Rotating Load

M.S. Darlow, A.J. Smalley, and R.E. Cunningham
Mechanical Technology, Inc., Latham, NY Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1599-1602, ASME (1979) 4 figs, 3 refs
(For primary document, see 80-1477)

Key Words: Dampers, Elastomeric dampers, Rotating structures, Dynamic tests, Numerical analysis

This paper presents the results of a program of analysis and test to determine the dynamic properties of elastomer cartridges operating under a rotating load. These measured properties were compared to predictions based on results of unidirectional tests with the same elastomer material.

80-1409

Nonlinear Response of Short Squeeze Film Dampers

D.L. Taylor and B.R.K. Kumar
Sibley School of Mech. and Aerospace Engrg., Cornell Univ., Ithaca, NY 14853, J. Lubric. Tech., Trans. ASME, 102 (1), pp 51-58 (Jan 1980) 15 figs, 9 refs

Key Words: Dampers, Squeeze-film dampers, Nonlinear response, Rotors (machine elements)

This paper considers the methodology of numerical integration for prediction of dynamic response of squeeze film damper systems. A planar rotor carried in a squeeze film damper with linear centering spring is considered. The transient response is found to be most sensitive to initial values of phase angle and phase angle velocity. Initial eccentricity and eccentric velocity are much less important. In general, of the two steady state solutions, the one with lower eccentricity appears to be more stable, with a larger domain of convergence. Examples show how premature termination of the integration can lead to erroneous conclusions.

80-1410

Experimental Investigation of the Dynamic Properties of Damped Structures

L. Pust

Inst. of Thermomechanics of Czechoslovak Academy of Sciences, Prague. Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 310-313, ASME (1979) 8 figs, 2 refs

(For primary document, see 80-1477)

Key Words: Natural frequencies, Mode shapes, Damped structures

A method for the evaluation of natural frequencies and mode shapes of complicated damped mechanical systems is presented. It is based on the measurement of their response to a harmonic signal. The vibration measuring instruments are connected to the "HP 9603A Measuring and Control System" with a large disc storage capacity for the complex response curves. The method is illustrated by means of an example measuring cylindrical shell vibrations.

80-1411

Study on a Variable Stiffness-Type Dynamic Damper with Eddy Current Damping

K. Seto

Dept. of Mech. Engrg., National Defense Academy, Yokosuka, Kanagawa, Japan, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 325-328, ASME (1979) 11 figs, 4 refs

(For primary document, see 80-1477)

Key Words: Magnetic damping, Machine tools, Dynamic stiffness

The paper shows the damping performance of a new type dynamic damper incorporating eddy current damping instead of oil damping. The spring stiffness of the dynamic damper is adjustable to match all possible changes of the natural frequency of main vibration systems.

FATIGUE

(See Nos. 1334, 1335, 1423, 1424, 1425, 1426, 1427, 1428)

ELASTICITY AND PLASTICITY

80-1412

Dynamic Flexural Deformations in an Ideal Fibre-Reinforced Slab

D.F. Parker

Dept. of Theoretical Mechanics, Univ. of Nottingham, Nottingham, UK, J. Engr. Math., 14 (1), pp 57-75 (Jan 1980) 6 figs, 16 refs

Key Words: Slabs, Fiber composites, Elastic media, Dynamic response

A kinematic description is derived for plane strain deformations of unrestricted amplitude in an incompressible material ideally reinforced parallel to one axis of Lagrangian coordinates. The deformation is simply related to the configuration of one reference 'fibre'. For a slab of uniform thickness, equations of motion are derived. They relate the motion of the central fibre to the resultant tensile and shearing loads over each cross section. The equations predict that, in many materials, flexural waves may propagate. In this paper only elastic materials are considered. Some novel differences are revealed by an analysis of the equations governing deformations on either side of a crease.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see Nos. 1300, 1389, 1404)

80-1413

Experience with a Field Computerized Vibration Analysis System

P. Ibanez and R.B. Spencer

ANCO Engineers, Inc., Santa Monica, CA, SAE Paper No. 791074, 12 pp, 10 figs, 1 table, 10 refs

Key Words: Vibration analyzers, Computer aided techniques

Experience with a minicomputer based field-portable vibration analysis system has been gained on several projects including a five story office building, a nuclear power plant containment and internal piping system, and an offshore oil platform. The purpose of the system is to acquire data on up to 64 channels and provide for the organization,

documentation, and presentation of the reduced data. Modal parameter identification software is also available. To date the system has proven to be a valuable extension of previous field testing methods. This paper reviews the system's design and its performance in several field tests.

80-1414
Theory of Torsion Pendulum of Three Components for Measurement of Snoek Damping in Sheet Specimen

Y. Iwasaki and K. Fujimoto
Res. Labs., Kawasaki Steel Corp., 1 Kawasaki-cho, Chiba 260, Japan, J. Phys. E. (Sci. Instr.), 12, pp 593-595 (July 1979) 3 figs, 9 refs

Key Words: Pendulums, Measuring instruments, Internal damping

A torsion pendulum of three components which contains the Collette pendulum as a special one is introduced. Uncoupling of damped, coupled oscillators associated with the three-component pendulum yields a simple type of symmetric arrangement different from the Collette pendulum. This new pendulum is shown to be equivalent to two pendulums of the Kê and inverted types. Applicability of the pendulum to measurement of Snoek damping in sheet specimens is discussed.

80-1415
Continuous Frequency Monitoring of a Super-Regenerative NQR Spectrometer

G. Alonzo and N. Bertazzi
Istituto di Chimica Generale, Universita di Palermo, Via Archirafi 26 90123, Palermo, Italy, J. Phys. E. (Sci. Instr.), 12, pp 589-590 (July 1979) 2 figs, 3 refs

Key Words: Frequency meters

The frequency of a super-regenerative oscillator can be measured and continuously monitored with a frequency counter suitably interfaced. A simple electrical circuit for the interface is proposed.

80-1416
'Theory' of the Torsion Pendulums: Is the Collette Analysis in Error?

M. Koiwa
Res. Inst. for Iron, Steel and Other Metals, Tohoku Univ., Sendai 980, Japan, J. Phys. E. (Sci. Instr.), 13, pp 27-30 (Jan 1980) 1 fig, 7 refs

Key Words: Pendulums, Measuring instruments, Internal damping

The equations of motion for torsion pendulums for various model solids are briefly described. It is shown that the formulae for internal friction derived by Iwasaki et al are only valid for the Voigt solids. Their criticism of the analysis of the composite torsion pendulum by Collette et al is shown to be inappropriate; the original analysis by Collette is essentially correct. An alternative treatment of the Collette pendulum is presented.

80-1417
Selection and Use of Tape Recorders with Noise and Vibration Measuring Equipment

J. Ruding
Hayden Labs. Ltd., Noise Control Vib. Isolation, 10 (9), pp 371-376 (Nov/Dec 1979) 8 figs

Key Words: Measuring instruments, Recording instruments

A brief description of direct recording, direct replay, FM recording, FM replay, and their application in the noise and vibration measurement technology is presented. Tape recorders used with sound and vibration equipment, choice of tape, and the maintenance of equipment are discussed.

80-1418
An Optical System for Measurement of Energy for Pendulum Impact Machines

G.R. Henderson and W.L. Server
GHI Systems, Inc., ISA Trans., 18 (3), pp 35-39 (1979) 4 figs, 2 tables, 3 refs

Key Words: Measuring instruments, Optical measuring instruments, Computer-aided techniques, Impact tests

Pendulum impact machines measure the energy required to fracture a test specimen by the change in potential energy before and after fracture. Charpy impact machines use a mechanical pointer system which senses this change in energy. Calibration and certification of Charpy impact machines include the testing of special specimens supplied by the Army Materials and Mechanics Research Center (AMMRC). This

paper compares the results obtained for the AMMRC tests and a series of pressure vessel steel tests when an auxiliary velocity sensing device is employed. Both the initial and final impact velocities were measured using a light sensing device, flags of known width, and a clock which measured time between flat pulses.

80-1419
Reinterpretation of the Reciprocity Theorem for the Calibration of Acoustic Emission Transducers Operating on a Solid

R. Hill and N.L. Adams
School of Physics, Robert Gordon's Inst. of Tech., Aberdeen, UK, Acustica, 43 (5), pp 305-312 (Dec 1979) 4 figs, 2 tables, 12 refs

Key Words: Transducers, Sound transducers, Calibrating

An approach is presented which expresses the process of reciprocity calibration in terms of transfer functions. Appropriate input/output parameters are defined and an approximate expression for $X(\omega)$ for a solid isotropic half space subjected to sinusoidal excitation is obtained. Application of the technique to the calibration of acoustic emission transducers is discussed. The problems of applying the derived transfer function $X(\omega)$ for finite media are discussed and suggestions for alternative measurement methods are indicated.

80-1420
A Theory for Optimization in the Use of Acoustic Emission Transducers

R. Hill and S.M.A. El-Dardiry
School of Physics, Robert Gordon's Inst. of Tech., Aberdeen, AB1 1HG, Scotland, UK, J. Acoust. Soc. Amer., 67 (2), pp 673-682 (Feb 1980) 6 figs, 4 tables, 29 refs

Key Words: Transducers, Acoustic emission

The measurement precision and the magnitude of acoustic emission signals is affected by the type and thickness of the couplant used to couple the transducer to a structure. A theoretical solution is provided to determine the transmission coefficient of a multilayer system of *n* layers.

80-1421
The Measurement of Shaft Torque in Micro-Alternators

D.W. Auckland and R. Shuttleworth
Electrical Engrg. Dept., Univ. of Manchester, Manchester M13 9PL, UK, J. Phys. E. (Sci. Instr.), 12, pp 1071-1074 (Nov 1979) 5 figs

Key Words: Shafts, Torque, Measurement techniques

A technique for measuring shaft torque in micro-alternators is described. A resistance strain gauge bridge is used. The output from the bridge is amplified and used to pulse-width-modulate a 20 kHz square wave. The modulated waveform is extracted from the shaft, using split brass rings and carbon-copper brushes, and demodulated to give a continuous record of shaft torque. In this way distortion of the torque signal by electromagnetic radiation and variation in contact resistance between brushes and slip rings is eliminated.

80-1422
Automatic Analysis of the Logarithmic Decrement in Damped Oscillations

E.M. Mezzetti
Istituto Fisica Sperimentale, Politecnico, Torino, Italy, J. Phys. E. (Sci. Instr.), 12, pp 1163-1165 (Dec 1979) 3 figs, 1 table, 11 refs

Key Words: Torsional vibration, Damped structures, Damping values, Measurement techniques, Viscosity

A new fully automated method for the accurate evaluation of the logarithmic decrement in damped torsional oscillations is presented. The method is based on the measurement of time intervals between successive passages of an oscillating cup at a fixed position corresponding to an angular displacement different from zero.

DYNAMIC TESTS

(Also see Nos. 1408, 1418, 1441, 1455)

80-1423
Sommerfeld Resonance Effect in Vibrating System with Variable Mechanical Parameters

M. Kobrin
Mech. Engrg. Dept., Ben Gurion Univ. of the Negev, Beer Sheva, Israel, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 416-419, ASME (1979) 6 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Vibrating structures, Variable material properties, Sommerfeld resonance effect, Fatigue tests

A theory is developed for the Sommerfeld Resonance Effect (SRE) in vibrating system (VS) subjected to cyclic loading and cumulative damage, with mechanical parameters varying in the process. The behavior of VS is examined under the dynamic conditions created by breakoff of the vibration on transition trough resonance. The exciter unit, which consists of a DC motor and a vibrator, is studied in terms of its working regime under dynamic instability of the vibration. The optimal relationship is determined for the characteristics of the motor and vibrator, so as to yield limiting transient dynamic regimes in the system for a given damage level. A description is given of the experimental set-up. Data were obtained on growth of the initial damage to the VE at different breakoff rates.

80-1424

Extreme Values of Stochastic Stress Vibrations in Machine Parts

M. Matolcsy
Dept. of Bus Development, Res. Inst. of Automobile Industry, Budapest, Hungary, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1208-1213, ASME (1979) 13 figs, 2 tables, 6 refs
(For primary document, see 80-1477)

Key Words: Fatigue tests, Machinery components

Failure of the machine parts generally takes place as a result of fatigue process, but under the direct effect of an extreme high stress. Therefore, the theory and the measuring practice of the extreme stresses, picking out them from the complex service stress vibration, requires a particular attention. Assuming the statistical behavior of stress vibration process to be known, defining some basic extreme value parameters, the distribution function of the extreme stresses can be derived theoretically. The paper shows the theoretical considerations, the special measuring method of extremes, and analyzes measured extreme stress distributions.

80-1425

Computer-Controlled Stress Intensity Gradient Technique for High Rate Fatigue Crack Growth Testing

J.K. Donald and D.W. Schmidt
Del Res. Div., PSC Professional Services Group, Inc., 427 Main St., Hellertown, PA 18055, J. Test Eval. (ASTM), 8 (1), pp 19-24 (Jan 1980) 6 figs, 5 tables, 5 refs

Key Words: Fatigue tests, Crack propagation, Computer-aided techniques

An automated test system utilizing a computer for data acquisition and machine control was used to obtain crack growth rate data. Crack growth data were obtained on a Ni-Cr-Mo-V rotor steel by using both different, programmed K gradients and the more conventional constant-load-amplitude method where the stress intensity increases as a function of increasing crack length. Excellent agreement was observed between the two test procedures.

80-1426

The Development of a Closed-Loop, Servo-Hydraulic Test System for Direct Stress Monotonic and Cyclic Crack Propagation Studies Under Biaxial Loading

I.M.H. Charvat and G.G. Garrett
De Beers Consolidated Mines Ltd., Kleinzee 8282, Republic of South Africa, J. Test Eval. (ASTM), 8 (1), pp 9-18 (Jan 1980) 11 figs, 37 refs

Key Words: Fatigue tests, Test facilities, Crack propagation

A rig with two orthogonal, servo-hydraulic actuators based around a universal testing machine provides a flexible, low-cost biaxial testing facility and has been used to examine the influence of direct biaxial stress on deformation and crack propagation, particularly in high cycle fatigue.

80-1427

The Development of the Biaxial Rotation Test for Fatiguing Fibres

I.E. Clark and J.W.S. Hearle
Dept. of Textile Tech., Univ. of Manchester Inst. of Science and Tech., P.O. Box 88, Manchester M60 1QD, UK, J. Phys. E. (Sci. Instr.), 12, pp 1109-1112 (Nov 1979) 6 figs, 7 refs

Key Words: Test equipment and instrumentation, Fatigue tests, Fibers

A new simplified apparatus has been developed for fatigue-testing fibres using the technique of biaxial rotation over a pin. This involves the tension-compression of fibres which are rotated whilst bent over a pin. The angle through which the fibre is bent during a fatigue test can be altered, and the effect of this on fatigue life and fracture morphology has been investigated.

80-1428

Dynamic Fundamentals of Designing Fatigue Testing Machines with Programmed Control

M.E. Garf

Institut of Mechanics of the Academy of Sciences of the Ukrainian SSR, Kiev, Ussr, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1372-1375, ASME (1979) 2 figs

(For primary document, see 80-1477)

(In Russian)

Key Words: Fatigue tests, Test equipment and instrumentation

In view of increased capacity of modern fatigue testing machines and of high demands on the information test results give, a solution of problems of dynamics of fatigue machines was required. On the basis of unification of assemblies and dynamic diagrams of machines, analytic characteristics were obtained, which allowed to optimize main parameters of vibrating systems. A number of features in the evaluation of fatigue test machines were introduced describing the efficiency and stability of tests. Results of optimization of dynamic diagrams and developed principle of aggregation of machines were used in the production of universal system, which is widely used in industry.

80-1429

Audiometry Reliability with a Noise Exposed Population

G.L. Cluff

Arizona State Univ., Tempe, AZ, S/V, Sound Vib., 14 (1), pp 18-20 (Jan 1980) 2 figs, 3 tables, 4 refs

Key Words: Testing techniques, Noise tolerance, Human response

The purpose of this study was to re-examine the test-retest reliability of repeated manual and Bekesy thresholds using a population of noise exposed adults. Comparison between manual and Bekesy thresholds, on an individual basis, should be avoided where possible.

80-1430

Combining Acoustic Holography with Space-Frequency Equivalence

W.E. Kock

Herman Schneider Lab., Engineering College, Univ. of Cincinnati, Cincinnati, OH 45221, J. Acoust. Soc. Amer., 67 (2), pp 578-580 (Feb 1980) 4 figs, 7 refs

Key Words: Acoustic holography, Space-frequency equivalence, Acoustic tests, Testing techniques

Space-frequency equivalence, a 1958 concept involving either electromagnetic or acoustic detection systems, states that the physical complexity of a system is interchangeable with the frequency complexity of the system so that the use of a multiplicity of discrete frequencies permits a significant reduction in the physical (space) extent of the system. The implications of combining this equivalence with holography are here examined.

SCALING AND MODELING

(Also see No. 1307)

80-1431

Wind-Tunnel Simulation of Wind-Structure Interactions

A. Kareem and J.E. Cermak

University of Houston, TX, ISA Trans., 18 (4), pp 23-41 (1979) 19 figs, 1 table, 48 refs

Key Words: Wind tunnel tests, Scaling, Interaction: structure-fluid, Wind-induced excitation

The objective of this paper is to present methods of wind-tunnel simulation of wind-structure interactions. The scaling criteria to achieve similitude between natural winds and simulated atmospheric flow in a wind tunnel, scale models, aeroelastic modeling of structures, and instrumentation are emphasized. Random-data acquisition and multivariate probabilistic and spectral analysis, and the prediction of fullscale aerodynamic loading and response of structures from measurements taken in the wind tunnel are discussed.

DIAGNOSTICS

(Also see No. 1456)

80-1432

Condition Monitoring - What is it and Who Needs it?

L. Plumb

Servodyne Controls, Noise Control Vib. Isolation, 10 (9), pp 351-354 (Nov/Dec 1979) 3 figs

Key Words: Diagnostic instrumentation, Diagnostic techniques

Machinery characteristics which should be monitored and the correct selection and mounting of measuring instruments are described.

80-1433

Diagnosing Rotating Equipment Ills with Vibration Measurement

C.A. Eubanks

Electro-Mechanical Div., Westinghouse Electric Corp., Cheswick, PA, Mach. Des., 52 (1), pp 86-92 (Jan 10, 1980)

Key Words: Diagnostic instrumentation, Rotors (machine elements), Rotating structures

Several probes and basic test instruments which are needed to detect vibration sources in rotating machinery before corrective action can be taken are described.

80-1434

Identification and Diagnostics of Rotary Machines

S.S. Korabljev and E.I. Fedotkin

Dept. of Theoretical and Appl. Mechanics, Inst. of Power Engrg., USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1218-1221, ASME (1979) 3 figs, 1 table, 2 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Diagnostic techniques, Parameter identification technique, Rotating structures

The determining of structural parameters deviations from their nominal values of rotary machines is the important problem of quality inspection. Method of determining of deviation is proposed, which is based on the diagnostic approach and differs from the usual diagnostic scheme by introducing the function model of the object in terms of the discrete Hammerstein model. Some problems of the proposed method are considered such as estimation of structural parameters, identification of the function model and etc. The results of digital computer simulation and natural experiments are included to demonstrate the feasibility of the proposed method.

80-1435

The Role of Vibration in Industry

R. Crawford

Acoustic Technology, Ltd., Noise Control Vib. Isolation, 10 (9), pp 356-360 (Nov/Dec 1979) 4 figs

Key Words: Diagnostic techniques, Dynamic tests

The application of vibration technology in machine health monitoring and dynamic testing is discussed and illustrated by case histories.

80-1436

Shock Spectrum Ratios Applied to the Comparison of Pulse Signatures

J.R. Houghton

Tennessee Technological Univ., Cookeville, TN 38501, J. Mech. Des., Trans. ASME, 102 (1), pp 64-76 (Jan 1980) 17 figs, 9 refs

Key Words: Diagnostic techniques, Shock response spectra, Signal processing techniques, Signatures, Acoustic signatures, Shock tests

Two extensions of the shock spectrum technique are developed for use in pulse signature analysis. A shock spectrum ratio is proposed and compared to the Fourier transfer function for the detection of small perturbations on a larger pulse shape. The shock spectrum ratio is shown to have good sensitivity to the relative size of the perturbation. The shock spectrum ratio approach is extended to a new type of spectrum named "slot transform." This specialized transform is shown to have several advantages with respect to the Fourier transform in the development of magnitude transfer functions.

80-1437

Vibration Analysis Pinpoints Coupling Problems

J.H. Maxwell

Union Carbide Corp., Taft, LA, Hydrocarbon Processing, 60 (1), pp 95-98 (Jan 1980) 11 figs

Key Words: Diagnostic techniques, Couplings

The interpretation of vibration data obtained by real time spectrum analyzers and shaft orbit displays in the investigation of sources of vibration caused by coupling problems are discussed. To illustrate the points discussed, several examples are presented.

80-1438

Predict Pump Problems with IFD

H.P. Bloch

Exxon Chemical Co., Baytown, TX, Hydrocarbon Processing, 60 (1), pp 87-94 (Jan 1980) 12 figs, 4 tables, 7 refs

Key Words: Diagnostic techniques, High frequency resonance technique, Pumps

Acoustic High Frequency Surveillance, sometimes called Incipient Failure Detection (IFD), has been successfully applied to monitor the condition of centrifugal pumps. Equipment for this purpose varies from simple portable monitors to sophisticated computer systems. Applications, field experience and justification of these systems are discussed.

80-1439

Maintenance Techniques for Turbomachinery

W.E. Nelson

Amoco Oil Co., Texas City, TX, Hydrocarbon Processing, 60 (1), pp 71-78 (Jan 1980) 6 figs, 9 refs

Key Words: Turbomachinery, Compressors, Monitoring techniques

Turbomachinery repair techniques that have evolved from experiences in a large gasoline refinery are presented. Engineering design problems and upgrading of all types of compressors, drivers, and accessories are discussed. Particular attention is given to barrel-type compressors and shop repairs.

80-1440

Effect of Radial Clearances in Hydraulic Spool Valves on the Static and Dynamic Characteristics of Servomechanisms

A. Baz, A. Barakat, and G. Rabie

Cairo Univ., Cairo, Egypt, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 785-788, ASME (1979) 8 figs, 3 refs

(For primary document, see 80-1477)

Key Words: Servomechanisms, Valves, Clearance effects, Diagnostic techniques

This article presents an experimental study of the effect of radial clearance in hydraulic spool valves on the static and dynamic characteristics of valve-driven servomechanisms in an attempt to devise quantitative diagnostic criteria that are helpful in predicting the service life of servovalves beyond which untolerable degradation in its performance would considerably affect the behavior of the servomechanism itself.

80-1441

Simple Method of Clearance Detection in Kinematic Pairs

C. Cempel

Technical Univ. of Posnan, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1368-1371, ASME (1979) 4 figs, 6 refs

(For primary document, see 80-1477)

Key Words: Bearings, Ball bearings, Clearance effects, Diagnostic techniques, Harmonic index

The paper gives theoretical foundations of clearances dynamical detection method which is based on new defined quantity called harmonic index. Clearance detecting and diagnostic ability of that quantity are illustrated by experiment on a group of ball bearings.

80-1442

The "Damage Mechanism" of Elements of Mechanisms

J. Muller

Wilheim-Peck-Universitat Rostock, Sektion Landtechnik, Ristock, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1188-1191, ASME (1979) 5 figs, 13 refs

(For primary document, see 80-1477)

(In German)

Key Words: Machinery components, Failure analysis

The interaction between damage and origins of damage with attention to the possibility of sequence damages can be described by the "Damage-mechanism" that is explained as a result of a systematic analysis of damages.

BALANCING

(Also see No. 1277)

80-1443

A Method of Site Balancing of Machine Systems

J. Wawrzecki

Technical Univ. of Lodz, Poland, Theory of Machines and Mechanisms, Proc of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 256-259, ASME (1979) 3 figs, 5 refs

(For primary document, see 80-1477)

Key Words: Balancing techniques, Machinery, Flexible foundations, Receptance method

This paper presents the method of balancing "on-site" of flexibly supported machine systems. The dynamic state of a system is determined by the amplitude-phase characteristic. Dependence between the vibrations of chosen points of the foundation on the machine and exciting forces is given by the influence coefficients called receptances. The solution of the problem is based on matrix calculus and obtained from a digital computer. The results show how to correct mass distribution of a rotor in order to diminish the vibrations in certain points of the machine-supporting structure system.

80-1444

Rapid-Action Wheel Suspension Mechanism

F. Sztanyik and G. Varga

Telecommunication Machine Factory of the Csepel Works "HITEKA," Budapest, Hungary, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 318-320, ASME (1979) 4 figs, 8 refs

(For primary document, see 80-1477)

Key Words: Balancing machines, Design techniques

The construction of simple wheel suspension mechanism for balancing machines is presented. It enables fastening and dismantling the wheel on a balancing machine within seconds.

80-1445

Comparison Between Some Methods for the Balancing of Flexible Rotors by Using Automatic Techniques

N. Bachschmid, B. Pizzigoni, G. Vallarino, and G. Zanolo

Dept. of Mech. Engrg., Politecnico of Milan, Milan, Italy, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1622-1625, ASME (1979) 3 figs, 4 refs

(For primary document, see 80-1477)

Key Words: Rotors (machine elements), Flexible rotors, Balancing techniques, Computer-aided techniques

The influence coefficients and a hybrid method for the balancing of flexible rotors are tested and compared by using an automated data processing system. The measuring and the data acquisition techniques are shown together with the balancing methods employed.

80-1446

Approximative Balancing of Flexible Rotor with Wide Band Which Unrolls

L. Cveticanin

Univ. in Novi Sad, V. Vlahovica, Yugoslavia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1637-1639, ASME (1979) 3 figs, 11 refs

(For primary document, see 80-1477)

Key Words: Rotors (machine elements), Flexible rotors, Balancing techniques

It is possible to denote the unbalance of flexible rotor with wide band frequencies which unroll.

80-1447

On the Balancing of Flexible Rotors Using Reduced Gradient Method

Y.P. Kakad and T.W. Lee

Univ. of North Carolina, Charlotte, NC, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1633-1636, ASME (1979) 2 figs, 12 refs

(For primary document see 80-1477)

Key Words: Rotors (machine elements), Flexible rotors, Balancing techniques

A new approach to the balancing of flexible rotors is presented. The unbalance of a rotor is treated as a combination of a number of discrete unbalancing components, which are identified and subsequently removed using an effective non-linear programming technique, namely, the reduced gradient method. The method allows the treatment of non-linear rotor response and design constraints. Some numerical examples are given and the results are compared to the ones obtained using other methods.

80-1448

Peculiarities of the Dynamic Balancing of Spatial Four-Bar Mechanisms

T.T. Gappoev and D.B. Tabuev

Mountain Agricultural Inst., Ordzhonikidze, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1420-1423, ASME (1979) 2 figs, 1 table, 11 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Balancing techniques, Dynamic balancing, Linkages

This paper considers the problem of the complete balancing of the inertia forces of a spatial hinge four-bar linkage and of the partial optimal balancing of their moments. The computation of the optimal parameters of spatial coordination of the corrective masses is carried out on the basis of the minimization of the mean quadratic deviation of the value of the residual moments of inertia forces.

ANALYSIS AND DESIGN

ANALYTICAL METHODS

(Also see Nos. 1290, 1301, 1358)

80-1449

A Method of Dynamic Synthesis in the Elastodynamics of Machinery Units

E.S. Stanchev and N. Minchev

Dept. of Technical Mechanics, Higher Marine School "N.Y. Vaptzarov," Varna, Bulgaria, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 227-230, ASME (1979) 1 fig, 5 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Dynamic synthesis, Machinery components

Proposed in the work is an essentially new method of dynamic synthesis of machinery units by a given integral quadratic degree of irregularity. Through the introduction of sensitivity functions, the problem is reduced to the solution of algebraic equations. The method has been developed for machinery units of "n" degrees of freedom and of arbitrary structure.

80-1450

Dynamic Invariants in the Statistical Elastodynamics of Machinery Units

N.D. Minchev

Dept. of Technical Mechanics, Higher Marine School "N.Y. Vaptzarov," Varna, Bulgaria, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 250-255, ASME (1979) 1 fig, 22 refs

(For primary document, see 80-1477)

(In Russian)

Key Words: Dynamic synthesis, Machinery components, Statistical analysis

A method of dynamic synthesis of machinery units is proposed whose generalized forces represent random functions of known statistical characteristics of the invariance condition. The problem has been solved for machinery units of degrees of freedom and of arbitrary structure.

80-1451

An Experimental Approach to Dynamic Identification of Mechanical Systems

B.Z. Sandler

Mech. Engrg. Dept., Ben Gurion Univ. of the Negev, Beersheva, Israel, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 144-147, ASME (1979) 5 figs

(For primary document, see 80-1477)

Key Words: Mechanisms, Mechanical systems, Fourier transformation, Laplace transformation, Dynamic synthesis

This work is an attempt to use the Fourier and Laplace transforms for analysis and optimal dynamic synthesis of some kinds of special nonlinearities in mechanisms. The mechanisms of state of motion are considered to be statistically stationary. The criteria for an optimal synthesis are stochastically specified. Hence, the spectral theory of random processes is used for the analytic data processing. A device for transfer function measurements (for these nonlinear cases) in real time is described and some measured examples are discussed.

80-1452

Describing Function Simulation of Dynamic Forces in Single Degree-of-Freedom Mechanisms

R.R. Allen and D.M. Rozelle

Mechanics and Structures Dept., School of Engrg. & Applied Science, Univ. of California, Los Angeles, CA, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 246-249, ASME (1979) 5 figs, 6 refs

(For primary document, see 80-1477)

Key Words: Single degree of freedom systems, Mechanisms, Dynamic excitation, Digital simulation, Describing function approach

This paper presents an efficient method for computing dynamic forces in single degree-of-freedom mechanisms. The forces are expressed in terms of a power series in the input velocity and a Fourier series in the input position. This method is shown to produce an excellent approximation and provide a substantial reduction in computational effort during simulation of mechanism dynamics.

80-1453

Dynamic Analysis of Mechanisms with Nonintegrable Constraints

D.N. Levitsky

Moscow Aviation Institute, Moscow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 571-573, ASME (1979) 1 ref

(For primary document, see 80-1477)

(In Russian)

Key Words: Dynamic structural analysis, Mechanisms, Hydraulic servomechanisms

In a mechanism with electromotor, nonintegrable constraints give the effect of damping. In a hydraulic mechanism with two cylinders and one pump, the equation of expediture is the nonintegrable constraint. The method of dynamic analysis may be applied to pneumatic mechanisms too.

80-1454

A Finite Element Approach to Kinematics and Dynamics of Mechanisms

K. van der Werff

Dept. of Mech. Engrg., Delft Univ. of Technology, Delft, The Netherlands, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 587-590, ASME (1979) 7 figs, 8 refs

(For primary document, see 80-1477)

Key Words: Mechanisms, Gears, Finite element technique, Kinematics, Dynamic response

The description of the kinematics of structures as given in the finite element method is a good starting point for the numerical treatment of mechanism analysis. In this analysis, the relations between deformations and displacements play a central role. For the calculation of the transfer functions methods are presented, applicable to mechanisms consisting of undeformable links. The description is completed with the formulation of dynamics, kinetostatics and vibrations. For mechanisms consisting of deformable links an approximate method is given. The use of the theory is demonstrated with some examples.

80-1455

Computation of Transient Vibrations Responding to Shock Excitation Functions by Linear Integral Operator Calculation

D. Findeisen

Bundensanstalt f. Material Prüfung, Berlin, Germany, Forsch. Ingenieurwesen, 45 (5), pp 137-151 (1979) 8 figs, 34 refs

Key Words: Shock tests, Simulation, Transient response

Idealized and standardized shock functions, which are used in simulation and shock testing, are analytically closed represented and Laplace-transformable by superposing the leading-

off-functions step and ramp function. The spectral components of shock functions are derived from the context between Laplace- and Fourier-transformation. The original shock responses in initial and residual period can be evaluated for the model of vibrating system simultaneously extraneous excited by driving-force and -motion of foot point with the aid of both convolution of time characterization (weighting function) with shock excitation and closed inverse transformation of transformed shock responses. The calculation of transient responses by means of linear function transformation with extended sphere of validity on safe mathematical basis (theory of distributions), used in dynamic systems theory, discloses cross-connexions to lines related to vibration theory, in particular, to technique of communication and to system control sciences.

80-1456

On a Digital Approach to the Analysis of Mechanical System Response Signals

G.D. Xistris and G.K. Boast
Concordia Univ., Montreal, Quebec, Canada, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1222-1225, ASME (1979) 5 figs, 9 refs
(For primary document, see 80-1477)

Key Words: Signal processing techniques, Digital techniques

This paper discusses the general criteria for the design of a signal analysis system utilizing digital equipment and techniques. The effect of equipment characteristics on the overall system performance is reviewed and methods for improving computation accuracy are identified.

MODELING TECHNIQUES

(Also see Nos. 1241, 1272, 1275, 1276, 1284, 1285, 1288, 1292, 1295, 1297, 1326)

80-1457

On the Dynamic Action and Vibrations of Large Systems with Periodic Motion

J.I. Wulfson
Leningrad Institut for Textiles and Light Industry, Leningrad, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1572-1575, ASME (1979) 2 figs, 2 tables, 5 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Mathematical models, Periodic excitation, Vibration control, Mechanisms

The vibrations of large rheonomic systems are investigated. A two-step modeling method for the widely extended and intermeshed systems with distributed and lumped parameters is presented. The criteria for the dynamic interaction of individual component systems are determined and a method for the reduction of vibration of mechanisms is proposed.

80-1458

The Determination of the Flexibility of Dynamic Systems by Means of Lagrange's Multi-Tree

J. Wojnarowski and J. Swider
Institute of the Fundamentals of Machine Design, Technical University of Silesia, Gliwice, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol I, July 8-13, 1979, Montreal, Canada, pp 223-226, ASME (1979) 7 figs, 8 refs
(For primary document, see 80-1477)

Key Words: Mathematical models, Dynamic stiffness

A new method of determining the dynamical flexibility of a complex mechanical system with the aid of Lagrange's multitrees has been presented in the paper. A method of constructing nonplanar graphs which are explicit in modeling mechanical systems with linear couplings has been worked out. This method is based on the definition of an independent hypercircuit, generalized node law and independent hypercircuit law formulated by the authors.

80-1459

The Application of Graphs and Structural Numbers in the Modelling of Vibration Machines

J. Wojnarowski
Inst. of the Fundamentals of Machine Design, Technical Univ. of Silesia, Gliwice, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1236-1239, ASME (1979) 4 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Machinery vibration, Mathematical models

The problem of applying and structural numbers to the modeling of machine vibrations has been formulated in the paper. An algebraical model and multitude operations have been applied to the methods given there and thanks to that

they are characterized by the full formalization and algorithmization of evaluations in the designation of dynamical characteristics. This method of carrying out numerical experiments concerning the dynamics of linear, discrete and continual mechanical systems may be an introduction to further investigations in the way of applying graphs and structural numbers in the modeling of vibrations of physical systems. The practical application of this method has been presented in the example.

80-1460
Dynamic Modelling of Stepping Motor Mechanisms

G. Bogelsack and E. Schron
Technische Hochschule Ilmenau, Ilmenau, German Democratic Republic, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1400-1403, ASME (1979) 5 figs, 4 refs
(For primary document, see 80-1477)
(In German)

Key Words: Mechanical systems, Machinery, Machinery components, Clearance effects, Elastic properties, Friction, Mathematical models

Mathematical modeling of the effects of clearance, elasticity and friction on the entire motion system, including the driving stepping motor and the functional elements, is described. The object is to derive a system with any combination of parts of required dynamic properties. Theoretical results are confirmed by experiment.

80-1461
Computer Modelling of Systems with Intermittent Motion

F.R.E. Crossley, A. Oledzki, K. Nazarczuk, and W. Szydlowski
Univ. of Massachusetts, Amherst, MA, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1384-1387, ASME (1979) 4 figs, 7 refs
(For primary document, see 80-1477)

Key Words: Mechanical systems, Simulation, Digital simulation, Mathematical models

The simulation of dynamic mechanical systems by digital computer can provide valuable assistance to a designer. The modeling of intermittent mechanisms involves switching by command from one set of differential equations to another; the same occurs in models of cam drives with dwell, and of couplings with backlash or with static friction. Major inaccuracies can occur on crossing any boundary, and step size must be reduced to avoid these. However, even a very complex model can produce excellent output that matches experimental results very well.

80-1462
Modelling of Pneumatic Drives

K. Nazarczuk
Inst. for Aircraft Engrg. and Appl. Mechanics, Technical Univ. of Warsaw, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1258-1261, ASME (1979) 3 figs, 2 refs
(For primary document, see 80-1477)

Key Words: Mathematical models, Mechanical drives, Pneumatic machine drives, Simulation, Computer programs

A mathematical model which uniformly describes all the periods of an actuator with rectlinear motion, as well as a program in the CSMP language, which may be used for digital simulation of various sytems with pneumatic drive is described.

NONLINEAR ANALYSIS
(See No. 1263)

NUMERICAL METHODS
(Also see No. 1408)

80-1463
Non-Linear Performance of Structures in Parallel or Centrifugal Force Fields

B.J. Hartz and J. Brunso
Univ. of Washington, Seattle, WA, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1588-1592, ASME (1979) 9 figs
(For primary document, see 80-1477)

Key Words: Numerical analysis, Rotating structures, Stability

Stability and stability of motion problems of structural and mechanical systems are formulated, retaining all terms of

significant orders of magnitude for each of the problems considered. They include a number of problems with circulatory and gyroscopic forces, conservative and non-conservative systems in parallel and centrifugal force fields, such as turbine blade vibration, and the "follower force" or tangentially loaded column stability problems of Beck, Ziegler, Hermann, et al. In these problems the influence of the load and/or the resistance mechanisms of the structures are functions of the deformations and/or velocities of deformation of the structure in linear and/or higher order terms in these dependent variables. Numerical solution procedures are developed and some typical examples are solved.

80-1464
Numerical Method of Integration at the Equation of Machine Motion

W. Ostachowicz
Technical Univ. of Gdansk, Gdansk, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1229-1231, ASME (1979) 2 figs, 5 refs
(For primary document, see 80-1477)

Key Words: Numerical analysis, Machinery vibration, Equations of motion, Computer programs

In the paper is shown the numerical method of solution equation of machine motion. The real machine is changed by adequate choosen, dynamic substitute model. On the basis of showed algorithm the author arranged program calculating said equation of motion.

STATISTICAL METHODS

80-1465
On the Dynamics of the Mechanical System with Certain Random Excitation

M. Dietrich and M. Terlikowska
Inst. Aircraft Engrg. and Appl. Mechanics, Technical Univ. of Warsaw, Warsaw, Poland, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1250-1253, ASME (1979) 9 figs, 1 ref
(For primary document, see 80-1477)

Key Words: Mechanical systems, Random excitation, Probability theory

In the paper the dynamic analysis of the mechanical system with some parameter values changing in discrete time is presented. Assuming that time of change is a random variable, the dynamic processes appearing after that change are random functions. For the given probability distribution of the discrete time of change of excitation the probability distribution of peak values of dynamic displacement for one degree of freedom system are investigated. The influence of the number of changes on probability distributions of the peak values is also investigated. The results of the analysis described in the paper can be applied in designing various machines and their parts (as clutches, brakes) while investigating their work in normal and average situations.

PARAMETER IDENTIFICATION
(Also see No. 1291)

80-1466
Dynamics of Systems with Alternating Parameters

W.I. Sokolowski and W.S. Parschin
Uraler Polytechnical Hochschule, Uraler, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 276-279, ASME (1979)
(For primary document, see 80-1477)

Key Words: Parameter identification technique, Machinery

Model of a class of real mechanical systems reproduced in the form of enumerable set of mechanical and electrical subsystems has been considered; mechanical and electrical subsystems permit discrete or continual description and interaction by means of their elements to be made. Continuous variations of the parameters, cyclic disturbancies and loads modulation by friction of the subsystems.

80-1467
Parametric Identification of Discrete-time SISO Systems

R.E. King and P.N. Paraskevopoulos
Dept. of Systems Engrg., Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia, Intl. J. Control, 30 (6), pp 1023-1029 (Dec 1979) 2 tables, 6 refs

Key Words: Parameter identification technique

The paper presents a method for the parametric identification of linear time-invariant discrete systems. The input and

output data sequences of the system are initially transformed into information-bearing sequences of much lower order through the use of discrete Laguerre series. The parameter identification problem then becomes one of finding the solution to an overdetermined set of equations. Data transformation into the Laguerre spectrum is achieved through a fast and efficient computational algorithm which inherently possesses noise-reduction properties.

MOBILITY/IMPEDANCE METHODS

(See No. 1434)

OPTIMIZATION TECHNIQUES

(Also see No. 1351)

80-1468

Global Optimization of Functions by the Random Optimization Method

N. Baba
Institut de Recherche d'Informatique et d'Automatique, Rocquencourt, B.P. 105, 178150 Le Chesnay, France, Intl. J. Control, 30 (6), pp 1061-1065 (Dec 1979) 9 refs

Key Words: Optimization, Stochastic processes

This paper is concerned with a study of convergent properties of the random optimization method for a stochastic unconstrained minimization problem. It is shown that global minimum can be found by the random optimization method.

80-1469

Optimization of Machine Parts Dynamic Calculation

E.K. Korovin
USSR Gosstandard, Moscow, USSR, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. II, July 8-13, 1979, Montreal, Canada, pp 1134-1136, ASME (1979) 2 figs, 5 refs
(For primary document, see 80-1477)
(In Russian)

Key Words: Machinery components, Optimization, Self-excited vibration, Forced vibration, Design techniques

The author examines the problems of calculating dynamically loaded machine and mechanism parts, which arise at the stage of designing, adjusting and operation of products. Basing on the analysis of the existing methods the author chooses the criteria and makes an optimization of calculations of self- and forced-frequencies and shapes of oscillations of machine standard elements. The paper presents algorithms for solving the problems by computers for designing. It is also proved that the optimized calculation methods reduce the designing period, raise the quality and dependability of products. The author gives recommendations for unification of the methods in question.

80-1470

Dynamic Multilevel Optimization for a Class of Non-Linear Systems

M.S. Mahmoud
Electronics and Communications Dept., Faculty of Engrg., Cairo Univ., Giza, Egypt, Intl. J. Control, 30 (6), pp 927-948 (Dec 1979) 8 figs, 10 refs

Key Words: Optimization, Non-linear systems, Dynamic systems

A three-level hierarchical computation structure is potentially developed to optimize the quadratic performance of a class of non-linear dynamic systems. This class includes interesting problems encountered in power systems operation. The powerful attribute of the technique developed lies in the efficient incorporation of the co-state coordination methodology and a suitable decomposition scheme. It also affords for both the simplification of the lower level computational task and the manipulation of the system's non-linearities. A systematic convergence proof is given in order to substantiate the asymptotic behavior of the optimization procedure. As a part of the work, quantitative comparisons of the computational properties and the ensuing results of the simulation studies of the developed technique with other hierarchical methods greatly enhance its relative superiority.

DESIGN TECHNIQUES

(Also see Nos. 1242, 1471)

80-1471

Multi-Critical Optimization of Parameters of a Mechanical System

O. Knaifl
Res. Institute of Agricultural Engrg., Praha, Czechoslovakia, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Mon-

treal, Canada, pp 659-662, ASME (1979) 2 figs, 4 tables, 2 refs
(For primary document, see 80-1477)

Key Words: Machinery, Design techniques, Optimization

In this article a discretization of the domain of parameters has been made and a rational solution of the dynamic features of the non-linear system has been searched for using the pseudo-random investigation into the parameter space by means of the Sobol sequences.

80-1472
Computer Aided Design of Mechanisms. The Cadom Project of the Delft University of Technology
H. Rankers
Delft, The Netherlands, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 667-672, ASME (1979) 12 figs, 16 refs
(For primary document, see 80-1477)

Key Words: Design techniques, Computer aided techniques, Mechanisms, Machinery

A catalog of mechanisms collects the necessary informations for synthesis and analysis of all mechanisms involved in the computer aided design procedure described herein. The catalog must also be used for interpreting the results of the approximate synthesis procedure.

80-1473
Automated Simulation and Display of Mechanism and Vehicle Behaviour
J.C. Wiley, B.E. Romig, N. Orlandea, T.A. Berenyi, and D.W. Smith
Deere & Company Technical Ctr., Moline, IL, Theory of Machines and Mechanisms, Proc of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 680-683, ASME (1979) 3 figs, 9 refs
(For primary document, see 80-1477)

Key Words: Simulation, Equations of motion, Graphic methods, Design techniques, Computer aided techniques, Ground vehicles

This paper describes the development and implementation of a system of general purpose software for investigating the dynamic behavior of complex machines whose parts undergo large scale two- and three-dimensional motions. This system automates the formulation of the equations of motion, generation of the solutions, and the presentation of results as realistic pictures with hidden lines removed in both still snapshot and animated forms. Examples taken from actual snowmobile, four-wheel-drive tractor, and reset plow simulations illustrate the effectiveness of the approach.

COMPUTER PROGRAMS
(Also see Nos. 1307, 1361, 1462, 1464)

80-1474
DYLOFLEX Modifications to FLEXSTAB. Volume 2: User's Manual. Volume 3: Programmer's Manual
P. Dauria
Boeing Commercial Airplane Co., Seattle, WA, Rept. No. NASA-CR-2863, D6-44472-V-2, 123 pp (Oct 1979)
N79-33160

Key Words: Computer programs

The changes made to the SD and SS program of the FLEXSTAB computer program system which allows it to be interfaced with the DYLOFLEX program system are described. The changes to specific pages in the FLEXSTAB user's manual are presented. The changes to specific pages in the FLEXSTAB programmer's manual are described. The changes were made for compatibility with the DYLOFLEX and were made in the 2.01 FLEXSTAB SD and SS program.

80-1475
Dynamic Analysis of Mechanisms Using Symbolical Equation Manipulation
E.J. Kreuzer
Institute B of Mechanics, University Stuttgart, Stuttgart, Federal Republic Germany, Theory of Machines and Mechanisms, Proc. of 5th World Congress, Vol. I, July 8-13, 1979, Montreal, Canada, pp 599-602, ASME (1979) 3 figs, 4 refs
(For primary document, see 80-1477)

Key Words: Equations of motion, Computer programs

For the dynamical analysis of machines and mechanisms, mathematical models consisting of rigid bodies, springs,

dashpots, servomotors and bearings are often used. A method for automatic equation generation is developed.

80-1476

A Program to Compute Three-Dimensional Subsonic Unsteady Aerodynamic Characteristics Using the Doublet Lattic Method, L216 (Dubfix). Volume 1: Engineering and Usage

M. Richard and B.A. Harrison

Boeing Commercial Airplane Co., Seattle, WA, Rept. No. NASA-CR-2849, D6-44458-V-1, 123 pp (Oct 1979)

N79-32163

Key Words: Computer programs, Aerodynamic characteristics, Aircraft

The program input presented consists of configuration geometry, aerodynamic parameters, and modal data; output includes element geometry, pressure difference distributions, integrated aerodynamic coefficients, stability derivatives, generalized aerodynamic forces, and aerodynamic influence coefficient matrices. Optionally, modal data may be input on magnetic file (tape or disk), and certain geometric and aerodynamic output may be saved for subsequent use.

GENERAL TOPICS

CONFERENCE PROCEEDINGS

80-1477

The Theory of Machines and Mechanisms, Proc. of 5th World Congress

July 8-13, 1979, Montreal, Canada, 2 Vols., ASME, 345 E. 47th St., New York, NY (1979)

(See selected individual titles)

Key Words: Proceedings, Machinery, Mechanisms

The Congress Proceedings contain over 350 papers contributed from 34 countries, the Keynote Addresses delivered by the President and Secretary of IFToMM and the Special Lectures presented by internationally-renowned engineers on robotics, man-machine interactions, biomechanics, manufacturing control of servomechanisms. The technical sessions cover various fields of machines and mechanisms and in particular, Kinematic Analysis and Synthesis, Dynamics of Machines and Mechanisms, Gearing and Transmissions, Preventive Maintenance and Reliability Control, Rotor-dynamics, Vibrations and Noise in Machines, Biomechanisms, Technology Transfer, Robots, Manipulators and Man-Machine Systems, Computer-aided Design and Optimization, Pneumatics, Hydraulics and Electro-dynamics, Industrial Applications for Special Machines and Mechanisms and Experimental and Teaching Methods.

AUTHOR INDEX

PERIODICALS SCANNED

PUBLICATION AND ADDRESS	ABBREVIATION
ACTA MECHANICA Springer-Verlag New York, Inc. 175 Fifth Ave. New York, NY 10010	Acta Mech.
ACUSTICA S. Hirzel Verlag, Postfach 347 D-700 Stuttgart 1 W. Germany	Acustica
AERONAUTICAL JOURNAL Royal Aeronautical Society 4 Hamilton Place London W1V 0BQ, UK	Aeronaut. J.
AERONAUTICAL QUARTERLY Royal Aeronautical Society 4 Hamilton Place London W1V 0BQ, UK	Aeronaut. Quart.
AIAA JOURNAL American Institute of Aeronautics and Astronautics 1290 Avenue of the Americas New York, NY 10019	AIAA J.
AMERICAN SOCIETY OF CIVIL ENGINEERS, PROCEEDINGS Publications Office, ASCE United Engineering Center 345 East 47th St. New York, NY 10017	
JOURNAL OF ENERGY *DIVISION*	ASCE J. *Energy Div.*
JOURNAL OF ENGINEERING MECHANICS DIVISION	ASCE J. Engr. Mech. Div.
JOURNAL OF ENVIRONMENTAL ENGINEERING DIVISION	ASCE J. Environ. Engr. Div.
JOURNAL OF GEOTECHNICAL ENGINEERING DIVISION	ASCE J. Geotech. Engr. Div.
JOURNAL OF HYDRAULICS DIVISION	ASCE J. Hydraulics Div.
JOURNAL OF IRRIGATION AND DRAINAGE DIVISION	ASCE J. Irrigation Drainage Div.
JOURNAL OF STRUCTURAL DIVISION	ASCE J. Struc. Div.
JOURNAL OF TRANSPORTATION ENGINEERING DIVISION	ASCE J. *Transport.* Engr. Div.
AMERICAN SOCIETY OF LUBRICATING ENGINEERS, TRANSACTIONS Academic Press 111 Fifth Ave. New York, NY 10019	ASLE, Trans.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS, TRANSACTIONS United Engineering Center 345 East 47th St. New York, NY 10017	
JOURNAL OF APPLIED MECHANICS	J. Appl. Mech., Trans. ASME
JOURNAL OF DYNAMIC SYSTEMS, MEASUREMENT AND CONTROL	J. Dyn. Syst., Meas. and Control, Trans. ASME
JOURNAL OF ENGINEERING FOR INDUSTRY	J. Engr. Indus., Trans. ASME
JOURNAL OF ENGINEERING FOR POWER	J. Engr. Power, Trans. ASME
JOURNAL OF LUBRICATION TECHNOLOGY	J. Lubric. Tech., Trans. ASME
JOURNAL OF MECHANICAL DESIGN	J. Mech. Des., Trans. ASME
JOURNAL OF PRESSURE VESSEL TECHNOLOGY	J. Pressure Vessel Tech., Trans. ASME
APPLIED ACOUSTICS Applied Science Publishers, Ltd. Ripple Road, Barking Essex, UK	Appl. Acoust.
APPLIED MATHEMATICAL MODELING IPC House 32 High St., Guildford Surrey GU1 3EW, UK	Appl. Math. Modeling
ARCHIVES OF ACOUSTICS Polish Academy of Sciences Committee on Acoustics Polish Acoustical Society	Arch. Acoust.
ARCHIVES OF MECHANICS (ARCHIWUM MECHANIKI STOSOWANEJ) Export and Import Enterprise Ruch UL, Wronia 23, Warsaw, Poland	Arch. Mech.
ASTRONAUTICS AND AERONAUTICS AIAA EDP 1290 Avenue of the Americas New York, NY 10019	Astronaut. & Aeronaut.
AUTOMOBILTECHNISCHE ZEITSCHRIFT Franckh'sche Verlagshandlung Abteilung Technik 7000 Stuttgart 1 Pfizerstrasse 5-7 W. Germany	Automobiltech. Z.

PUBLICATION AND ADDRESS	ABBREVIATION
AUTOMOTIVE ENGINEER (SAE) Society of Automotive Engineers, Inc. 400 Commonwealth Drive Warrendale, PA 15096	*Auto.* Engr. (SAE)
AUTOMOTIVE ENGINEER (UK) P.O. Box 24, Northgate Ave. Bury St., Edmunds Suffolk IP21 GBW, UK	Auto. Engr. (UK)
BALL BEARING JOURNAL (English Edition) SKF (U.K.) Ltd. Luton, Bedfordshire LU3 1JF, UK	Ball Bearing J.
BROWN BOVERI REVIEW Brown Boveri and Co., Ltd. CH-5401, Baden, Switzerland	Brown Boveri Rev.
BULLETIN DE L'ACADEMIE POLONAISE DES SCIENCES, SERIES DES SCIENCES TECHNIQUES Ars Polona-Ruch 7 Krokowskie Przedmiescie, Poland	Bull. Acad. Polon. Sci., Ser. Sci. Tech.
BULLETIN OF JAPAN SOCIETY OF MECHANICAL ENGINEERS Japan Society of Mechanical Engineers Sanshin Hokusei Bldg. H-9 Yoyogi 2-chome Shibuya-ku Tokyo 151, Japan	Bull. JSME
BULLETIN OF SEISMOLOGICAL SOCIETY OF AMERICA Bruce A. Bolt Box 826 Berkeley, CA 94705	Bull. Seismol. Soc. Amer.
CIVIL ENGINEERING (NEW YORK) ASCE Publications Office 345 E. 47th St. New York, NY 10017	Civ. Engr. (N.Y.)
COMPUTERS AND STRUCTURES Pergamon Press Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Computers Struc.
DESIGN NEWS Cahners Publishing Co., Inc. 221 Columbus Ave. Boston, MA 02116	Des. News
DIESEL AND GAS TURBINE PROGRESS Diesel Engines, Inc. P.O. Box 7406 Milwaukee, WI 53213	Diesel Gas Turbine Prog.
ENGINEERING MATERIALS AND DESIGN IPC Industrial Press Ltd. 33-40 Bowling Green Lane London EC1R, UK	Engr. Matl. Des.
EXPERIMENTAL MECHANICS Society for Experimental Stress Analysis 21 Bridge Sq., P.O. Box 277 Westport, CT 06880	Exptl. Mech.
FORSCHUNG IM INGENIEURWESEN Verein Deutscher Ingenieur, GmbH Postfach 1139 Graf-Recke Str. 84 4 Düsseldorf 1 W. Germany	Forsch. Ingenieurw.
HEATING/PIPING/AIR CONDITIONING Circulation Dept. 614 Superior Ave. West Cleveland, OH 44113	Heating/ Piping/ Air Cond.
HYDRAULICS AND PNEUMATICS Penton/IPC, Inc. 614 Superior Ave., West Cleveland, OH 44113	Hydraulics & Pneumatics
HYDROCARBON PROCESSING Gulf Publishing Co. Box 2608 Houston, TX 77001	Hydrocarbon Processing
IBM JOURNAL OF RESEARCH AND DEVELOPMENT International Business Machines Corp. Armonk, NY 10504	*IBM J. Res. Dev.*
INDUSTRIAL RESEARCH Dun-Donnelley Publishing Corp. 222 S. Riverside Plaza Chicago, IL 60606	Indus. Res.
INGENIEUR-ARCHIV Springer-Verlag New York, Inc. 175 Fifth Ave. New York, NY 10010	Ing. Arch.
INSTITUTE OF MARINE ENGINEERS, TECHNICAL REPORTS The Memorial Building 76 Mark Lane London EC3R 7IN, UK	Inst. Mar. Engr., T.R.
INSTITUTION OF ENGINEERS, AUSTRALIA, CIVIL ENGINEERING TRANSACTIONS 11 National Circuit Barton, A.C.T. 2600, Australia	Instn. Engr., Austral., C.E. Trans.
INSTITUTION OF ENGINEERS, AUSTRALIA, ELECTRICAL ENGINEERING TRANSACTIONS 11 National Circuit Barton, A.C.T. 2600, Australia	Instn. Engr., Austral., E.E. Trans.
INSTITUTION OF MECHANICAL ENGINEERS, (LONDON), PROCEEDINGS Institution of Mechanical Engineers 1 Birdcage Walk, Westminster, London SW1, UK	Instn. Mech. Engr. Proc.
INSTRUMENT SOCIETY OF AMERICA, TRANSACTIONS Instrument Society of America 400 Stanwix St. Pittsburgh, PA 15222	*ISA Trans.*
INTERNATIONAL JOURNAL OF CONTROL Taylor and Francis Ltd. 10-14 Macklin St. London WC2B 5NF, UK	Intl. J. Control
INTERNATIONAL JOURNAL OF EARTHQUAKE ENGINEERING AND STRUCTURAL DYNAMICS John Wiley and Sons, Ltd. 650 Third Ave. New York, NY 10016	Intl. J. Earthquake Engr. Struc. Dynam.

PUBLICATION AND ADDRESS	ABBREVIATION
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES Pergamon Press Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Intl. J. Engr. Sci.
INTERNATIONAL JOURNAL OF FATIGUE IPI Science and Technology Press Ltd. P.O. Box 63, Westbury House, Bury Street Guildford Surrey, England GU2 5BH	Intl. J. Fatigue
INTERNATIONAL JOURNAL OF MACHINE TOOL DESIGN AND RESEARCH Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Intl. J. Mach. Tool Des. Res.
INTERNATIONAL JOURNAL OF MECHANICAL SCIENCES Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Intl. J. Mech. Sci.
INTERNATIONAL JOURNAL OF NONLINEAR MECHANICS Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Intl. J. Nonlin. Mech.
INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING John Wiley and Sons, Ltd. 605 Third Ave. New York, NY 10016	Intl. J. Numer. Methods Engr.
INTERNATIONAL JOURNAL FOR NUMERICAL AND ANALYTICAL METHODS IN GEOMECHANICS John Wiley and Sons, Ltd. Baffins Lane Chichester, Sussex, UK	Intl. J. Numer. Anal. Methods Geomech.
INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Intl. J. Solids Struc.
INTERNATIONAL JOURNAL OF VEHICLE DESIGN The International Assoc. of Vehicle Design The Open University, Walton Hall Milton Keys MK7 6AA, UK	Intl. J. Vehicle Des.
ISRAEL JOURNAL OF TECHNOLOGY Weizmann Science Press of Israel Box 801 Jerusalem, Israel	Israel J. Tech.
JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA American Institute of Physics 335 E. 45th St. New York, NY 10010	J. Acoust. Soc. Amer.
JOURNAL OF AIRCRAFT American Institute of Aeronautics and Astronautics 1290 Avenue of the Americas New York, NY 10019	J. Aircraft
JOURNAL OF THE AMERICAN HELICOPTER SOCIETY American Helicopter Society, Inc. 30 E. 42nd St. New York, NY 10017	J. Amer. Helicopter Soc.
JOURNAL OF ENGINEERING MATHEMATICS Academic Press 198 Ash Street Reading, MA 01867	J. Engr. Math.
JOURNAL OF ENVIRONMENTAL SCIENCES Institute of Environmental Sciences 940 E. Northwest Highway Mt. Prospect, IL 60056	J. Environ. Sci.
JOURNAL OF FLUID MECHANICS Cambridge University Press 32 East 57th St. New York, NY 10022	J. Fluid Mech.
JOURNAL OF THE FRANKLIN INSTITUTE Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	J. Franklin Inst.
JOURNAL OF HYDRONAUTICS American Institute of Aeronautics and Astronautics 1290 Avenue of the Americas New York, NY 10019	J. Hydronautics
JOURNAL OF THE INSTITUTE OF ENGINEERS, AUSTRALIA Science House, 157 Gloucter Sydney, Australia 2000	J. Inst. Engr., Austral.
JOURNAL OF MECHANICAL ENGINEERING SCIENCE Institution of Mechanical Engineers 1 Birdcage Walk, Westminster London SW1 H9, UK	J. Mech. Engr. Sci.
JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	J. Mech. Phys. Solids
JOURNAL OF PHYSICS E. (SCIENTIFIC INSTRUMENTS) American Institute of Physics 335 East 45th St. New York, NY 10017	J. Phys. E. (Sci. Instr.)
JOURNAL OF SHIP RESEARCH Society of Naval Architects and Marine Engineers 20th and Northhampton Sts. Easton, PA 18042	J. Ship Res.
JOURNAL OF SOUND AND VIBRATION Academic Press 111 Fifth Ave. New York, NY 10019	J. Sound Vib.

PUBLICATION AND ADDRESS	ABBREVIATION
JOURNAL OF SPACECRAFT AND ROCKETS American Institute of Aeronautics and Astronautics 1290 Avenue of the Americas New York, NY 10019	J. Spacecraft Rockets
JOURNAL OF TESTING AND EVALUATION (ASTM) American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103	J. Test Eval. (ASTM)
KONSTRUKTION Spring Verlag 3133 Connecticut Ave., N.W. Suite 712 Washington, D.C. 20008	Konstruktion
LUBRICATION ENGINEERING American Society of Lubrication Engineers 838 Busse Highway Park Ridge, IL 60068	Lubric. Engr.
MACHINE DESIGN Penton Publishing Co. Penton Bldg. Cleveland, OH 44113	Mach. Des.
MASCHINENBAUTECHNIK VEB Verlag Technik Oranienburger Str. 13/14 102 Berlin, E. Germany	Maschinenbautechnik
MECCANICA Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Meccanica
MECHANICAL ENGINEERING American Society of Mechanical Engineers 345 E. 45th St. New York, NY 10017	Mech. Engr.
MECHANICS RESEARCH AND COMMUNICATIONS Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Mech. Res. Comm.
MECHANISM AND MACHINE THEORY Pergamon Press, Inc. Maxwell House, Fairview Park Elmsford, NY 10523	Mech. Mach. Theory
MEMOIRES OF THE FACULTY OF ENGINEERING, KYOTO UNIVERSITY Kyoto University Kyoto, Japan	Mem. Fac. Engr. Kyoto Univ.
MTZ MOTORTECHNISCHE ZEITSCHRIFT Franskh'sche Verlagshandlung Pfizerstrasse 5-7 7000 Stuttgart 1 W. Germany	MTZ Motortech. Z.
NAVAL ENGINEERS JOURNAL American Society of Naval Engineers, Inc. Suite 507, Continental Bldg. 1012 - 14th St., N.W. Washington, D.C. 20005	Naval Engr. J.
NOISE CONTROL VIBRATION ISOLATION Trade and Technical Press Ltd. Crown House, Morden Surrey SM4 5EW, UK	Noise Control Vib. Isolation
NOISE CONTROL ENGINEERING P.O. Box 3206, Arlington Branch Poughkeepsie, NY 12603	Noise Control Engr.
NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, TRANSACTIONS Bolbec Hall Newcastle upon Tyne 1, UK	NE Coast Instn. Engrs. Shipbldrs., Trans.
NUCLEAR ENGINEERING AND DESIGN North Holland Publishing Co. P.O. Box 3489 Amsterdam, The Netherlands	Nucl. Engr. Des.
OIL AND GAS JOURNAL The Petroleum Publishing Co. 211 S. Cheyenne Tulsa, OK 74101	Oil Gas J.
PACKAGE ENGINEERING 5 S. Wabash Ave. Chicago, IL 60603	Package Engr.
PLANT ENGINEERING 1301 S. Grove Avenue Barrington, IL 60010	Plant Engr.
POWER P.O. Box 521 Hightston, NJ 08520	Power
POWER TRANSMISSION DESIGN Industrial Publishing Co. Division of Pittway Corp. 812 Huron Rd. Cleveland, OH 44113	Power Transm. Des.
PRODUCT ENGINEERING (NEW YORK) McGraw-Hill Book Co. P.O. Box 1622 New York, NY	Product Engr. (NY)
QUARTERLY JOURNAL OF MECHANICS AND APPLIED MATHEMATICS Wm. Dawson & Sons, Ltd. Cannon House Folkestone, Kent, UK	Quart. J. Mech. Appl. Math.
REVUE ROUMAINE DES SCIENCES TECHNIQUES, SERIE DE MÉCANIQUE APPLIQUEE Editions De L'Academie De La Republique Socialiste de Roumaine 3 Bis Str., Gutenberg, Bucurest, Romania	Rev. Roumaine Sci. Tech., Mecanique
REVIEW OF SCIENTIFIC INSTRUMENTS American Institute of Physics 335 East 45th St. New York, NY 10017	Rev. Scientific Instr.
SAE PREPRINTS Society of Automotive Engineers Two Pennsylvania Plaza New York, NY 10001	SAE Prepr.

PUBLICATION AND ADDRESS	ABBREVIATION
SIAM JOURNAL ON APPLIED MATHEMATICS Society for Industrial and Applied Mathematics 33 S. 17th St. Philadelphia, PA 19103	SIAM J. Appl. Math.
SIAM JOURNAL ON NUMERICAL ANALYSIS Society for Industrial and Applied Mathematics 33 S. 17th St. Philadelphia, PA 19103	SIAM J. Numer. Anal.
S/V, SOUND AND VIBRATION Acoustic Publications, Inc. 27101 E. Oviat Rd. Bay Village, OH 44140	S/V, Sound Vib.
TECHNISCHES MESSEN - ATM R. Oldenburg Verlag GmbH Rosenheimer Str. 145 8 Munchen 80, W. Germany	Techn. Messen-ATM
TURBOMACHINERY INTERNATIONAL Turbomachinery Publications, Inc. 22 South Smith St. Norwalk, CT 06855	Turbomach. Intl.
VDI ZEITSCHRIFT Verein Deutscher Ingenieur GmbH Postfach 1139, Graf-Recke Str. 84 4 Düsseldorf 1, Germany	VDI Z.
VDI FORSCHUNGSHEFT Verein Deutscher Ingenieur GmbH Postfach 1139, Graf-Recke Str. 84 4 Düsseldorf 1, Germany	VDI Forsch.
VEHICLE SYSTEMS DYNAMICS Swets and Zeitlinger N.V. 347 B. Herreweg Lisse, The Netherlands	Vehicle Syst. Dyn.
WAVE MOTION North Holland Publishing Co. P.O. Box 211 1000 AE Amsterdam The Netherlands	Wave Motion
WEAR Elsevier Sequoia S.A. P.O. Box 851 1001 Lausanne 1, Switzerland	Wear
ZEITSCHRIFT FÜR ANGEWANDTE MATHEMATIK UND MECHANIK Akademie Verlag GmbH Liepziger Str. 3-4 108 Berlin, Germany	Z. angew. Math. Mech.
ZEITSCHRIFT FÜR FLUGWISSENSCHAFTEN DFVLR D-3300 Braunschweig Flughafen, Postfach 3267 W. Germany	Z. Flugwiss

SECONDARY PUBLICATIONS SCANNED

GOVERNMENT REPORTS ANNOUNCEMENTS & INDEX NTIS U.S. Dept. of Commerce Springfield, VA 22161	GRA
SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402	STAR
DISSERTATION ABSTRACTS INTERNATIONAL University Microfilms Ann Arbor, MI 48106	DA

ANNUAL PROCEEDINGS SCANNED

INSTITUTE OF ENVIRONMENTAL SCIENCES, ANNUAL PROCEEDINGS Institute of Environmental Sciences 940 E. Northwest Highway Mt. Prospect, IL 60056	Inst. Environ.
INTERNATIONAL CONGRESS ON ACOUSTICS, ANNUAL PROCEEDINGS	Intl. Cong. Acoust., Proc.
THE SHOCK AND VIBRATION BULLETIN, UNITED STATES NAVAL RESEARCH LABORATORIES, ANNUAL PROCEEDINGS Shock and Vibration Information Center Naval Research Lab., Code 5804 Washington, D.C. 20375	Shock Vib. Bull., U.S. Naval Res. Lab., Proc.

CALENDAR

JUNE 1980

11 Experimental Techniques for Fatigue Crack Growth Measurement [SEE] British Rail Technical Centre *(SEE Hq.)*

22-26 Summer Annual Meeting [ASME] Waldorf-Astoria, New York, NY *(ASME Hq.)*

JULY 1980

7-11 Recent Advances in Structural Dynamics Symp., [Institute of Sound and Vibration Research] University of Southampton, Southampton, S09 5NH, UK *(Mrs. O.G. Hyde, ISVR Conference Secretary, The University, Southampton, S09 5NH, UK - Tel (0703) 559122, Ext. 2310)*

SEPTEMBER 1980

2-4 International Conference on Vibrations in Rotating Machinery [IMechE] Cambridge, England *(Mr. A.J. Tugwell, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ, UK)*

8-11 Off-Highway Meeting and Exposition [SAE] MECCA, Milwaukee, WI *(SAE Hq.)*

OCTOBER 1980

Stapp Car Crash Conference [SAE] Detroit, MI *(SAE Hq.)*

Joint Lubrication Conference [ASME] Washington, D.C. *(ASME Hq.)*

6-8 Computational Methods in Nonlinear Structural and Solid Mechanics [George Washington University & NASA Langley Research Center] Washington, D.C. *(Professor A.K. Noor, The George Washington University, NASA Langley Research Center, MS246, Hampton, VA 23665 - Tel (804)827-2897)*

21-23 51st Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, D.C.] San Diego, CA *(Henry C. Pusey, Director, SVIC, Naval Research Lab., Code 5804, Washington, D.C. 20375)*

NOVEMBER 1980

18-21 Acoustical Society of America, Fall Meeting [ASA] Los Angeles, CA *(ASA Hq.)*

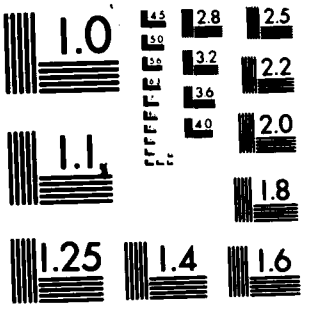
DECEMBER 1980

Aerospace Meeting [SAE] San Diego, CA *(SAE Hq.)*

8-10 INTER-NOISE 80 [International Institute of Noise Control Engineering] Miami, FL *(INTER-NOISE 80, P.O. Box 3469, Arlington Branch, Poughkeepsie, NY 12603)*

AD-A138 199 THE SHOCK AND VIBRATION DIGEST VOLUME 12 NUMBER 6(U) 2/2
NAVAL RESEARCH LAB WASHINGTON DC SHOCK AND VIBRATION
INFORMATION CENTER J NAGLE-ESHLEMAN JUN 80

UNCLASSIFIED F/G 20/11 NL



CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AFIPS: American Federation of Information Processing Societies
210 Summit Ave., Montvale, NJ 07645

AGMA: American Gear Manufacturers Association
1330 Mass. Ave., N.W.
Washington, D.C.

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics, 1290 Sixth Ave.
New York, NY 10019

AIChE: American Institute of Chemical Engineers
345 E. 47th St.
New York, NY 10017

AREA: American Railway Engineering Association
59 E. Van Buren St.
Chicago, IL 60605

ARPA: Advanced Research Projects Agency

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASNT: American Society for Nondestructive Testing
914 Chicago Ave.
Evanston, IL 60202

ASQC: American Society for Quality Control
161 W. Wisconsin Ave.
Milwaukee, WI 53203

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

CCCAM: Chairman, c/o Dept. ME, Univ. Toronto,
Toronto 5, Ontario, Canada

ICF International Congress on Fracture
Tohoku Univ.
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

ONR: Office of Naval Research
Code 40084, Dept. Navy
Arlington, VA 22217

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
6 Conduit St.
London W1R 9TG, UK

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375

URSI-USNC: International Union of Radio Science - U.S. National Committee
c/o MIT Lincoln Lab.
Lexington, MA 02173